



Northeastern University  
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**Graduate  
School  
of  
Professional  
Accounting**

**Northeastern  
University**

**Equal Opportunity Policy** Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees. Inquiries concerning our equal opportunity policies may be referred to the University Affirmative Action Officer and/or the Title IX coordinator.

## Message to Students

The program of the Graduate School of Professional Accounting at Northeastern University in Boston is designed specifically for liberal arts and other non-accounting majors. The School was established to help satisfy the accounting profession's need for persons with broad liberal education and a high-quality professional education.

The distinctive feature of the 15-month program—a three-month internship with a public accounting firm—is in keeping with the basic philosophy of Northeastern, whose undergraduate colleges and some graduate programs operate on the Cooperative Plan. The Graduate School of Professional Accounting is fully accredited by the American Assembly of Collegiate Schools of Business.

Boston is a world-famous educational and cultural center. Northeastern University is located in the Back Bay area within a short distance of the Museum of Fine Arts, the Isabella Stewart Gardner Museum, and Symphony Hall, home of the Boston Symphony and Pops Orchestras.

More than 600 students from more than 200 universities and colleges have enrolled since the School was established in 1965. Contributions by individual accounting firms have enabled many of these students to receive substantial financial aid in the form of scholarships.

We appreciate your interest and look forward to hearing from you.

Joseph M. Golemme  
Director, Graduate School of  
Professional Accounting and  
Harold A. Mock Professor of Accounting



## The Accounting Profession Today

Although recent economic conditions have caused cutbacks in employment opportunities for many professions, professional accounting is still growing not only in numbers, but in influence. The professional accountant's responsibilities, duties, and prestige have increased significantly during the last 50 years. Demand has never been so critical for qualified people at high levels of responsibility in public accounting. Advancement in the field is limited only by individual ability and is very rapid for the highly qualified.

Successful professional accountants obtain great personal satisfaction from their work, which is demanding and challenging. The earnings of successful accountants compare favorably with those of practitioners in other leading professions. Also, partners of large national certified public accounting firms have approximately the same incomes as presidents of large corporations.

The accounting profession offers a broad selection of employment opportunities. Accountants will find a wide range of alternatives within the individual firm, whether they associate with a large or small organization. In addition, the individual CPA may choose to operate independently. The accountant can also branch into industry or government and still maintain professional status.

The Graduate School of Professional Accounting at Northeastern University prepares the qualified college graduate for entrance into this most challenging and rewarding profession within a period of 15 months. The curriculum includes an internship experience during the middle three months.

## **What is a CPA?**

The letters "CPA" stand for "Certified Public Accountant," a designation based on state licensing procedures for the public practice of accounting. This public practice has led to the general recognition of accounting as a profession. It has all of the responsibilities common to every profession and includes a unique obligation to the public interest and a wide degree of independence to support that obligation.

The work of a CPA may be divided into three broad categories: auditing, taxation, and management advisory services. These three functions have expanded rapidly in recent years to keep pace with the increasing complexities of the business world. Management advisory services, the newest of the three, covers such diverse activities as the design and installation of accounting systems, production control analyses, market research, and operations research.

The computer has produced major changes in the accounting records that auditors examine for clients. Presently, more and more firms are teaching their staffs about computer applications to help them better serve the needs of clients operating on an automated accounting system. Auditors have needed to develop techniques for auditing around the computer, using the computer itself either principally or as a key tool. In fact, many CPA firms have computer time-sharing equipment in their offices for statistical sampling and other applications.

Increasingly, CPAs are asked to accept broader and more technical responsibilities. The result of this increased responsibility is an ever-growing demand for able, well-educated persons in the accounting profession. The personal qualifications needed by successful



CPAs are diverse: a high level of intelligence; a keen, inquiring, and analytical mind; mature judgment; ability in oral and written communications; a pleasing personality and appearance; and professional motivation and standards.

### **The CPA Examination**

The CPA Examination, given annually in May and November, is primarily a screening device intended to measure the minimum competence required to perform the duties of a CPA, protect the public interest effectively, and maintain the standards of the profession. The requirements for the CPA certificate vary from state to state, but the uniform two-and-one-half-day examination (19 hours), prepared by the American Institute of Certified Public Accountants, is used in all states.

The accounting profession is a demanding one, and the successful professional accountant must prepare thoroughly for professional responsibilities. In recent years, the trend toward graduate education for careers in professional accounting has accelerated. In fact, many members of the profession are convinced that formal education beyond the undergraduate level should become a requirement for the CPA Examination.

Northeastern's 16-course, graduate-level program leading to the degree of Master of Science in Accounting provides the student with both the specific education needed to write the CPA Examination and the broader foundation needed for future growth and advancement in the accounting profession. Graduates have excelled in both areas and have received many awards, including the coveted gold and silver medals for outstanding achievement on CPA Examinations.

## **Admission Requirements**

### **DEGREE**

All applicants to the Graduate School of Professional Accounting must be graduates of an accredited college or university by the time they begin their graduate studies.

### **PREREQUISITES**

Since the program is designed for liberal arts graduates, applicants *cannot* be accounting majors. We strongly recommend a background of at least six hours of economics and several college mathematics courses.

### **PERSONAL INTERVIEW**

The interview should be held at the applicant's school or at Northeastern. If neither of these options is feasible, arrangements can be made for the prospective student to be interviewed by a representative of a public accounting firm in a city near his/her home.

### **REFERENCES**

The names of at least three persons, preferably college professors, who know the applicant's personal qualities, academic achievements, and potential for graduate study are required.

### **GRADUATE MANAGEMENT ADMISSIONS TEST**

This test should be taken no later than January, since both financial aid and admissions decisions cannot be made until the test scores have been received by the Graduate School of Professional Accounting. The Educational Testing Service in Princeton, New Jersey, schedules this test each year in January, March, July, and November. Scores are received approximately four weeks after the test is taken.

### **UNDERGRADUATE GRADES**

Grades are evaluated for evidence of academic ability and promise of personal

growth and development. Because of the competitive nature of the admissions process and the limited size of the class, a strong undergraduate record is a key element in the admissions decision. Other important factors are GMAT scores and an assessment by the Admissions Committee of the candidate's personal accomplishments, motivation, and potential for success in both the Graduate School and the field of professional accounting.

#### **FEE**

All applications must be accompanied by a nonrefundable application fee of \$25. Checks payable to Northeastern University should be sent directly to the office of the Graduate School of Professional Accounting, Room 206 Hayden Hall.

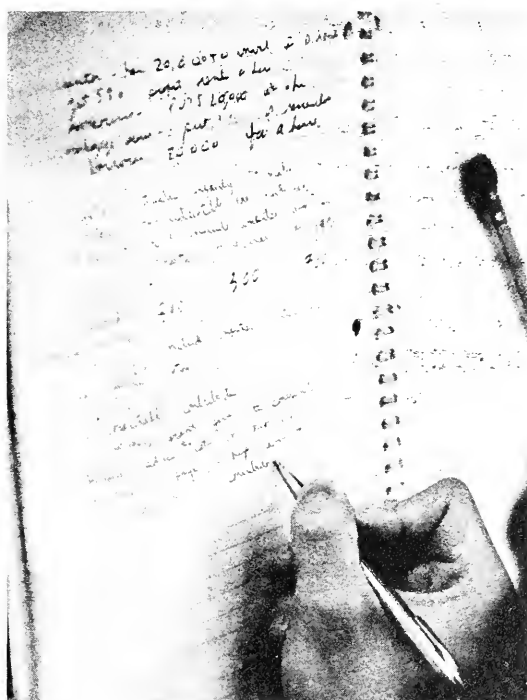
#### **Degree Requirements**

To receive the degree of Master of Science in Accounting, students must complete 80 hours of required course work with a minimum quality point average of 3.00. The months of January, February, and March are spent in internship with an accounting firm. Satisfactory performance during this three-month internship is also a degree requirement of the 15-month program.

# PROGRAM OF STUDY

Dates apply to Class of 1978

Number	Course	Credits	
<i>First Summer Quarter 1977</i>			
(June 13 to September 2)			
41.810	Accounting Principles	5	
41.820	Accounting Problems I	5	
45.812	Organizational Behavior	5	
41.840	Cost Accounting Theory and Problems	5	20
<i>Fall Quarter</i>			
(September 26 to December 16)			
41.850	Auditing Theory and Practice	5	
41.860	Federal Income Tax Accounting	6	
41.870	Accounting Problems II	5	
45.910	Business and Society	4	20
<i>Winter Quarter</i>			
(January 2 to March 31)			
Internship in the employ of a CPA firm			
<i>Spring Quarter</i>			
(April 3 to June 9)			
41.960	Accounting Problems III	5	
43.850	Marketing	5	
45.920	Operations Management	5	
49.920	Managerial Economics (Quantitative Approach)	5	20
<i>Second Summer Quarter 1978</i>			
(June 12 to September 1)			
41.890	Contemporary Accounting Theory	5	
44.830	Management of Financial Resources	5	
49.930	Business Law	5	
45.980	Business Policy	5	20
Total			80



## Description of Courses

### 41.810 ACCOUNTING PRINCIPLES

An accelerated introduction to the basic accounting process. Study in the areas of cash, marketable securities, receivables, inventories, current liabilities, plant and equipment, and intangible assets. Supplementary workshops are offered for all students to provide practical application to the theory and principles covered in class. A prerequisite to the course is completion of a self-instruction, programmed text on the basic accounting concepts. *Essentials of Accounting*, written by Robert N. Anthony and published by Addison-Wesley, is recommended.

### 41.820 ACCOUNTING PROBLEMS I

A continuation of 41.810, covering paid-in capital, retained earnings, long-term investments and liabilities, pension plans and long-term leases, statement analysis, cash/-fund flow, and price level adjustments/cash-level assessment.

### 41.840 COST ACCOUNTING THEORY AND PROBLEMS

Specialized problems of cost accumulation and analysis of a manufacturing operation. Understanding different costs, such as standard, direct, marginal, relevant, fixed, and differential. The importance of such costs in marginal decision-making is given special attention.

### 41.850 AUDITING THEORY AND PRACTICE

Audit concepts, standards, and procedures, including the legal and ethical responsibilities of the accounting profession. Emphasis is placed more on understanding the nature and objectives of the audit than on any specific technique of auditing. A simulated audit is performed by the student as an integral part of the course.

#### 44.830 MANAGEMENT OF FINANCIAL RESOURCES

The financial management of corporations and the principles governing the effective management of capital. The various sources of funds—short-, intermediate-, and long-term—are discussed in detail, using selected cases for illustrative purposes. Financial institutions, such as the SEC and the securities markets, are also studied.

#### 45.812 ORGANIZATIONAL BEHAVIOR

Behavior in formal (business) organizations. However, this knowledge is also applicable to other formal organizations, such as schools, government agencies, hospitals, and nonprofit organizations, including community groups and social clubs. Students acquire knowledge of behavior and develop skill in dealing with it as it exists and as they affect and change it.

#### 45.980 BUSINESS POLICY

Cases dealing with top-level management. The integrated approach necessary for top-level policy formulation and administrative decisions.

#### 45.910 BUSINESS AND SOCIETY

Interrelationships between managers of business organizations and other segments of society (stockholders, customers, suppliers, the public, and government) are explored to develop student understanding. The initial viewpoint is that of society examining management. Later, the perspective is changed to that of the manager, who examines constraints imposed by the changing social goals and values.

#### 45.920 OPERATIONS MANAGEMENT

Problem areas of scheduling, plant layout, and cost data as related to the production process. Topics include: systems design, work methods, and other fundamentals of standards development, inventory, and quality control.

49.920 MANAGERIAL ECONOMICS  
(Quantitative Approach)

Topics covered include decision making under conditions of uncertainty; allocation of scarce resources utilizing linear programming models; determination of the value of a marginal unit of a scarce resource (concept of shadow price); sensitivity analysis; examination of the most frequently encountered sampling distributions; determination of optimal decision rules; and economic models for estimating demand and cost relationships.

49.930 BUSINESS LAW

Agency, contracts, corporations, negotiable instruments, sales, and other topics most frequently covered in the CPA Law Examination.

41.960 ACCOUNTING PROBLEMS III

A continuation of 41.870, covering installment sales, consignments, corporate liquidation and reorganization, estates and trusts, governmental accounting and interim and segmental reporting.

43.850 MARKETING

Students acquire a comprehensive understanding of basic marketing functions, institutions, and concepts. They also develop the ability to analyze and make recommendations on management problems involving the creation, distribution, and sale of goods and services. Topics include consumer analysis, market research, and decisions as related to overall marketing strategy (product identification of target markets, specification of offerings, pricing, promotion, and distribution).

41.860 FEDERAL INCOME TAX ACCOUNTING

A comprehensive study of the Internal Revenue Code and Regulations. Emphasis is placed on those areas which are of maximum importance to the professional accountant.



1.870 ACCOUNTING PROBLEMS II

Topics covered: partnerships and joint ventures, branch accounting, consolidation, and foreign exchange.

1.890 CONTEMPORARY ACCOUNTING THEORY

Contemporary accounting problems and theory examined through selected case studies. Attention is focused on those areas of greatest concern to the accounting profession. The significance and limitations of generally accepted accounting principles, as well as the evolutionary process involved in their development.



## **Internship**

The first two quarters in the Graduate School of Professional Accounting are specifically designed to prepare students for their internships with leading public accounting firms. The internships, which take place during the winter quarter, occur between two halves of an intensive academic program.

During their internships, students gain valuable practical experience in the field. They are then well prepared to undertake the second half of their academic program.

Students earn approximately \$3,000 during their internships, which are arranged through the facilities of the Northeastern University Division of Cooperative Education and the Graduate School of Professional Accounting. Early in the spring quarter, they must complete a report on the internship experience. Satisfactory performance during the internship is a requirement for graduation.

Internships may take place in most large cities in the United States. Although every effort is made to place individual students in their city of preference, opportunities for placement are greater if they can intern in cities outside the Greater Boston area.

All former students have been provided an internship with a certified public accounting firm. Nevertheless, economic conditions and individual variables make it impossible for the Graduate School of Professional Accounting to guarantee internship placements. However, every effort will be made by the staffs of the Graduate School and participating CPA firms to assist students in obtaining internships.

### **Tuition and Other Costs**

Tuition — \$1,200 for each of the four academic quarters (subject to change) \$4,800

General Fees — Registration, Health Service, Student Center, Graduation, etc., payable in four installments \$ 200

Books — Minimum \$ 300

Total \$5,300

Less — Earnings from internship (approx.) \$3,000

Estimated Net Cost to Student \$2,300

These prices do not include room, board, laundry, or any personal expenses.

### **Financial Aid**

No qualified student should permit financial needs to preclude an application for admission to the Graduate School of Professional Accounting. Tuition scholarships, ranging from \$1,000 to \$4,000, are available. Scholarships are based on the applicants academic performance and GMAT score, and are awarded directly by the Graduate School of Professional Accounting. National Direct Student Loans also are available, along with a limited number of Martin Luther King, Jr. Scholarships for black students. Arrangements for these loans should be made through the Financial Aid Office, 252 Richards Hall, Northeastern University.

## Faculty

Joseph R. Curran, *Associate Professor of Accounting*; B.S., M.B.A., Northeastern University; Ph.D., Columbia University.

Michael L. Feters, *Assistant Professor of Accounting*; B.S., Ohio State University; M.B.A., Ph.D., University of Wisconsin.

Joseph M. Golemme, *Harold A. Mock Professor of Accounting*; B.S., Northeastern University; M.A., Boston University; C.P.A.

Robert H. Hehre, *Associate Professor of Finance*; B.S., M.S., Columbia University; M.B.A., D.B.A., Indiana University; C.P.A.

Paul A. Janell, *Assistant Professor of Accounting*; B.S., Northeastern University; M.B.A., Babson College; Ph.D., Michigan State University.

Richard Lindhe, *Associate Professor of Accounting*; B.S., M.Ed., Kent State University; Ph.D., University of Chicago.

Sitikantha Mahapatra, *Assistant Professor of Business Administration*; B.E., Original Engineering College, India; P.G.D.M., Indian Institute of Management, Calcutta, Division of Sloan School, Massachusetts Institute of Technology; Ph.D., Case Western Reserve University.

Wesley M. Marple, *Professor of Finance*; A.B., Princeton University; M.B.A., D.B.A., Harvard University.

Phillip R. McDonald, *Professor of Marketing*; B.A., University of British Columbia; M.B.A., D.B.A., Harvard University.

Russell W. Olive, *Professor of Management*; B.S., M.S., Massachusetts Institute of Technology; M.B.A., Boston University; D.B.A., Harvard University.

Daniel Scioletti, *Associate Professor of Law*; B.B.A., Colby College; L.L.B., Suffolk University; Ed.M., Boston University.

Albert Slavin, *Lillian L. and Harry A. Cowan Professor of Accounting*; Ed.B., Ed.M., Boston University; C.P.A.

Alan D. Tobin, *Lecturer in Accounting*; B.S., Northeastern University; L.L.B., Boston University; L.L.M., New York University; C.P.A.



## Visiting Professors

The faculty is supplemented each year through the unique Visiting Professorship program at Northeastern University. This program draws upon outstanding educators with the widest range of current ideas in the various specialty areas of business and accounting, thus giving the student body an enriching environment for professional development.

Following are the Visiting Professors who have served in the ten years of the School's existence, together with the institutions represented.

Robert Albanese, Texas A & M University

Roy E. Baker, University of Missouri

William B. Barrett, University of Arizona

Louis F. Biagioni, Indiana University

Homer A. Black, Florida State University

Edwin C. Bomeli, Bowling Green State University

Edwin A. Bump, Eastern Washington State College

Charles Calhoun, University of South Carolina

P. William Capatch, Kent State University

Charles Carpenter, Pennsylvania State University

Paul Dascher, Drexel University

Robert C. Ernest, Florida State University

Ralph W. Estes, University of Texas

W. Baker Flowers, University of Alabama

James M. Fremgen, U.S. Naval Postgraduate School

Charles Gibson, University of Toledo

Jack Gray, University of Minnesota

Gary T. Holstrum, University of Texas at Austin

Thomas D. Hubbard, Virginia Polytechnic Institute

William Huizingh, Arizona State University

Leroy Imdieke, Arizona State University

Harvey Kahalas, Virginia Polytechnic Institute

Patrick S. Kemp, University of Richmond

Larry N. Killough, Virginia Polytechnic Institute

Harold Q. Langenderfer, University of North  
 Carolina  
 Wayne Leininger, Virginia Polytechnic Institute  
 Ralph Malandro, Kent State University  
 Ralph Matz, University of Pennsylvania  
 Edward V. McIntyre, Florida State University  
 Robert A. Meier, San Diego State College  
 Joseph S. Merrill, Utah State University  
 Lawrence Merville, University of Texas at Dallas  
 Mary E. Murphy, California State College  
 Gordon Nielsen, Arizona State University  
 Vern E. Odmark, California State University  
 James R. Omph, University of Hawaii  
 William M. Parker, Fresno State College  
 Donald J. Patten, University of Connecticut  
 Daniel Pearl, Louisiana State University  
 New Orleans  
 Kenneth W. Perry, University of Illinois  
 William Petty, Texas Tech University  
 Larry Pointer, Texas A & M University  
 Mary M. Powell, University of Notre Dame  
 Mac N. Reynolds, University of North Carolina  
 Alan H. Savage, University of Texas  
 Kenneth Simmonds, University of Manchester,  
 Manchester, England  
 K. B. Stephenson, Ohio University  
 John W. Stevenson, Texas Christian University  
 Robert H. Strawser, Texas A & M University  
 Julius H. Terrell, University of North Carolina  
 Sherman Tingey, Arizona State University  
 Milton F. Usry, Oklahoma State University  
 Robert W. Wessel, University of Cincinnati  
 Thomas Wheelen, University of Virginia  
 Percy B. Yeargan, University of Georgia





## **Advisory Council**

A professional school must have a highly competent faculty, well-designed curricula, and qualified students. In addition, it must keep abreast of developments in the profession it represents. The Graduate School of Professional Accounting is fortunate to have the following distinguished representatives of leading public accounting firms as members of its advisory council.

Howard Hanson, C.P.A., *Chairman, Advisory Council*

Partner, Peat, Marwick, Mitchell & Co.

Clark Chandler, C.P.A.

Partner, Coopers and Lybrand

William Curley, C.P.A.

Partner, Arthur Andersen & Co.

Hugh Dysart, Jr., C.P.A.

Partner, Touche, Ross & Co.

Robert Kitchin, C.P.A.

Partner, Alexander Grant & Co.

Arthur G. Koumantzelis, C.P.A.

Partner, Arthur Young & Co.

Robert Leavy, C.P.A.

Partner, Clarence Rainess & Co.

Richard Mekleburg, C.P.A.

Partner, Laventhol & Horwath

Paul G. Smith, C.P.A.

Partner, Ernst & Ernst

Frank Stotz, C.P.A.

Partner, Price Waterhouse & Co.

Alan Tobin, C.P.A.

Partner, Tobin, Waldstein & Co.

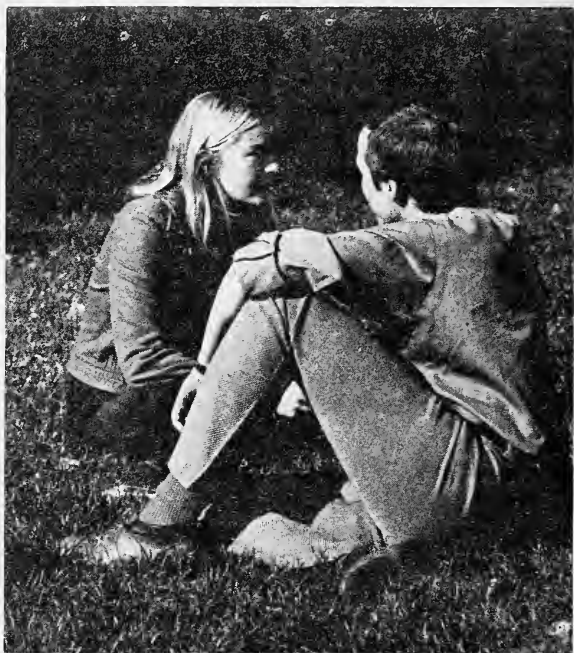
William Wright, C.P.A.

Partner, Haskins & Sells

# **Representative Colleges and Universities Previously Attended by Students of the Graduate School of Professional Accounting**

Adelphi University	Florida, University of
Alabama State College	Franklin College
Albany State College	Furman University
Albertus Magnus College	George Washington University
Alfred University	Georgetown University
Allegheny College	Georgia Institute of Technology
American International College	Hamilton College
American University	Hampton Institute
Arizona State University	Hartford, University of
Arkansas A & M College	Hartwick College
Assumption College	Harvard University
Barnard College	Haverford College
Bates College	High Point College
Boston College	Hiram College
Boston University	Hofstra University
Bowdoin College	Holy Cross College
Brandeis University	Hope College
Brigham Young University	Howard University
Brooklyn College	Illinois Wesleyan University
Brown University	Indiana State College
Case Western Reserve	Indiana University
Catholic University	Iowa Wesleyan College
Centre College of Kentucky	Ithaca College
Chatham College	John Carroll University
Cincinnati, University of	Kalamazoo College
City University of New York	Kansas, University of
Clark University	Knox College
Clarkson Institute of Technology	LeMoyne College
Colby College	Loras College
Colgate University	Louisville, University of
Colorado, University of	Loyola University of Chicago
Colorado State	Maine, University of
Columbia University	Manhattanville College
Columbus College	Marietta College
Connecticut College	Maryland, University of
Connecticut, University of	Massachusetts Institute
Cornell College	of Technology
Cornell University	Massachusetts Maritime
Dartmouth College	Academy
Drexel Institute of Technology	Massachusetts, University of
Drury College	McGill University
Edinboro College	Merrimack College
Fairfield University	Michigan State University
Florida State University	

Michigan, University of	St. Bonaventure University
Middlebury College	St. Francis College
Morgan State College	St. John's College
Mount Holyoke College	St. Michael's College
Muhlenberg College	St. Lawrence University
New Hampshire, University of	Simmons College
New Mexico, University of	Sir George Williams University
Newton College	Skidmore College
North Carolina, University of	Smith College
North Central College	South Carolina, University of
Northern Michigan University	State University of New York
Northeastern University	Stonehill College
Norwich University	Suffolk University
Notre Dame University	Syracuse University
Ohio State University	Texas Christian University
Ohio Wesleyan University	Trinity College
Olivet College	Tufts University
Oregon, University of	Union College
Pembroke College	U.S. Naval Academy
Pennsylvania Military College	Vanderbilt, University of
Pennsylvania State University	Vermont, University of
Pennsylvania, University of	Virginia, University of
Pittsburgh, University of	Washington & Jefferson College
Plymouth State College	Wellesley College
Princeton University	Wells College
Providence College	Wesleyan University
Purdue University	Western Carolina College
Radcliffe College	Westfield State College
Regis College	Wheaton College
Rensselaer Polytechnic Institute	Williamette University
Rhode Island, University of	Williams College
Rochester, University of	Wisconsin, University of
Rutgers, The State University	Worcester Polytechnic Institute
Santa Clara University	Yale University
Sarah Lawrence University	Yeshiva University
St. Anselm's College	



### **Northeastern University**

Northeastern University is a private, nonsectarian, coeducational university established in 1898. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of nearly 180 distinguished business and professional men and women.

Northeastern has 10 undergraduate colleges, 10 graduate and professional schools, a Center for Continuing Education, and a Center for Management Development.

The Northeastern campus consists of major facilities in Boston and Burlington, athletic facilities in Brookline, the Henderson House Conference Center in Weston, the Warren Center for Physical Education and Recreation Education in Ashland, and the Marine Science Institute in Nahant.

Inquiries concerning the Graduate School of Professional Accounting should be addressed to Professor Joseph M. Golemme, Director, Harold A. Mock Professor of Accounting, Graduate School of Professional Accounting, Room 206 Hayden Hall, Northeastern University, 60 Huntington Avenue, Boston, Massachusetts 02115. Tel. 617-437-3244.

### Delivery of Services

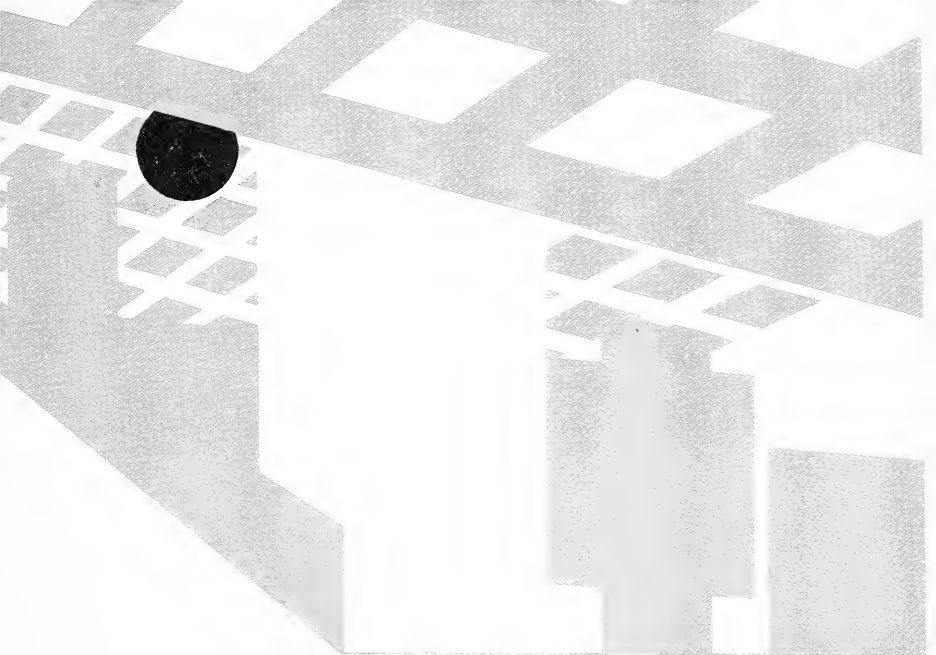
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Conducted on the  
Northeastern University  
Cooperative Plan of Education  
Accredited by the  
American Assembly of  
Collegiate Schools of Business

NORTHEASTERN UNIVERSITY 1975-76  
GRADUATE PROGRAM IN CRIMINAL JUSTICE







NEW ENGLAND  
ASSOCIATION  
OF SCHOOLS  
AND COLLEGES  
ACCREDITED MEMBER

Northeastern University  
144 Knowles-Volpe  
360 Huntington Avenue  
Boston, Massachusetts 02115  
Telephone (617) 437-3327

**NORTHEASTERN UNIVERSITY 1975-76  
GRADUATE PROGRAM IN CRIMINAL JUSTICE**

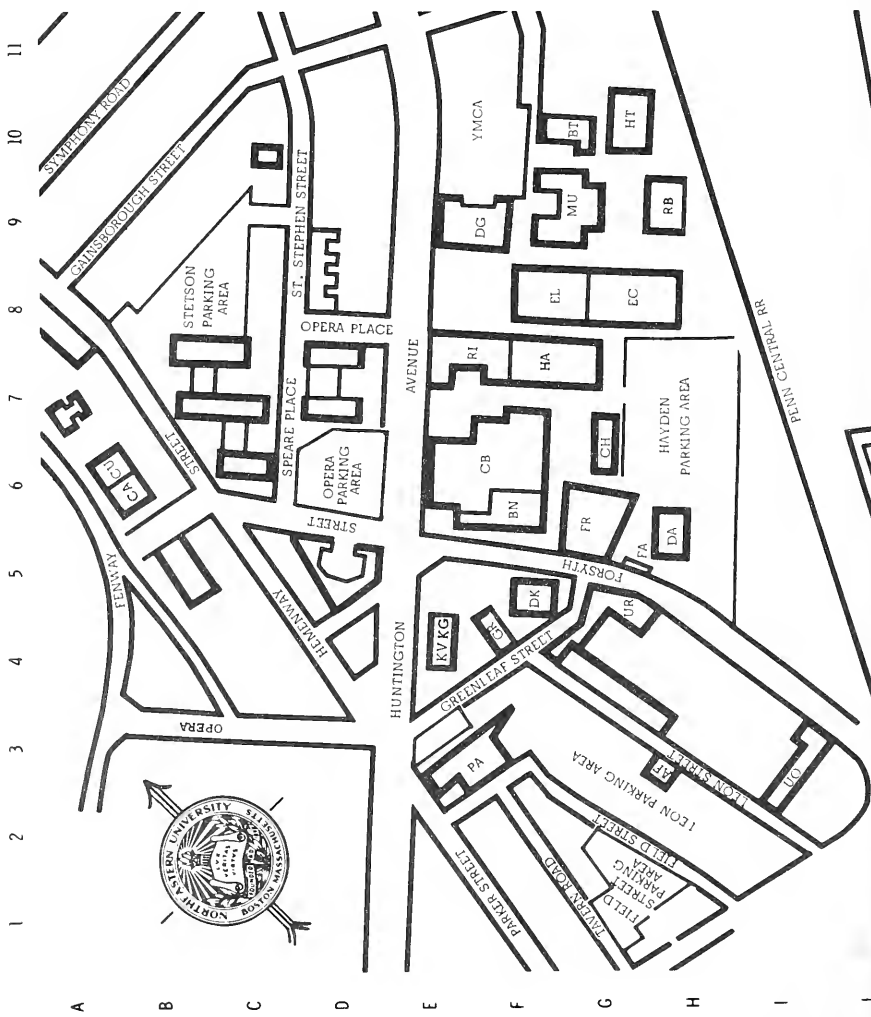


NORTHEASTERN UNIVERSITY

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**Building**

Barletta Natatorium  
Botolph Building  
Cabot Physical Education Ctr.  
Churchill Hall  
Cushing Hall  
Dana Research Center  
Dockser Hall  
Dodge Library  
Ell Student Center and Alumni Auditorium  
Forsyth Building  
Forsyth Building Annex  
Greenleaf Building  
Hayden Hall  
Hurtig Hall  
Cahners Hall  
Knowles Center (Volpe)  
Knowles Center (Gryzmish)  
11 Leon Street  
African-American Institute  
Mugar Life Sciences Building  
Parker Building  
Richards Hall  
Robinson Hall  
United Realty Building

**Building  
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**ACADEMIC CALENDAR 1975-1976**

**Fall Quarter 1975**

Registration period (1:00-3:00 and 5:30-8:00 p.m.)		
Boston	Monday-Thursday	Sept. 22-Sept. 25
Classes begin	Monday	September 29
Last day to drop a course	Wednesday	November 26
Examination period	Monday-Friday	Dec. 15-Dec. 19

**Winter Quarter 1975-1976**

Registration period (1:00-3:00 and 5:30-8:00 p.m.)		
Boston	Monday-Thursday	Dec. 8-Dec. 11
Classes begin	Monday	January 5
Last day to drop a course	Friday	March 5
Examination period	Monday-Friday	Mar. 22-Mar. 26

**Spring Quarter 1976**

Registration period (1:00-3:00 and 5:30-8:00 p.m.)		
Boston	Monday-Thursday	Mar. 15-Mar. 18
Classes begin	Monday	April 5
Last day to drop a course	Friday	June 4
Examination period	Monday-Friday	June 14

**Summer Quarter 1976**

Registration period (5:30-8:00 p.m.)		
Boston	Wednesday & Thursday	June 16 & 17
Classes begin	Monday	June 28

**UNIVERSITY HOLIDAYS 1975-1976**

Columbus Day	Monday	October 13
Veterans' Day	Monday	October 27
Thanksgiving Recess	Thursday-Saturday	Nov. 27-Nov. 29
Christmas Vacation	Monday-Friday	Dec. 22-Jan. 2
Martin Luther King's Birthday	Thursday	January 15
Washington's Birthday	Monday	February 23
Patriots Day	Monday	April 19
Memorial Day	Monday	May 31
Independence Day	Monday	July 5
Labor Day	Monday	September 6

### **Equal Opportunity Policy**

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admission, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or physical or mental handicap. In addition, Northeastern takes affirmative action in the recruitment of students and employees.

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**1975-1976**

The Council determines broad policies and regulations governing the conduct of graduate work. All new graduate programs must be approved by the Council.

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Arlis Aron	Parshotam Madan
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Frederick Blanc	Irene Nichols
Paul V. Croke	Barbara Philbrick
Ernest M. DeCicco	John D. Post
Romine Deming	Nathan Riser
Austin Fisher	Alae-Eldin Sayed
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James Gozzo	Victor Warner
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Stephen Schafer, *Professor of Criminal Justice*  
Larry Siegel, *Assistant Professor of Criminal Justice*  
Donna Turek, *Assistant Professor of Criminal Justice*



# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature, by special enactment, has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of 170 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922), Liberal Arts (1935), Education (1953), Pharmacy (1962), Nursing (1964), Boston-Bouv  College (1964), the College of Criminal Justice (1967), and Lincoln College's daytime Bachelor of Engineering Technology program (1971). As an educational method, the Cooperative Plan enables students to gain valuable practical experience as an integral part of their college program, and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses — offered by the University since 1906 — and adult-day courses leading to the bachelor's degree. In addition to offering day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The ten graduate and professional schools of the University offer day and evening programs leading to the degrees listed.

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.

The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science.

The Graduate School of Business Administration offers the degree of Master of Business Administration.

The Graduate Program in Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degree of Master of Education and the Certificate of Advanced Graduate Study.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer degree, Doctor of Engineering, and Doctor of Philosophy.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

## **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established in 1960 to relate the University to the needs of its community in a period of accelerated change. Adult education programs offered by the Center and University College have since been consolidated. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

## **RESEARCH ACTIVITIES**

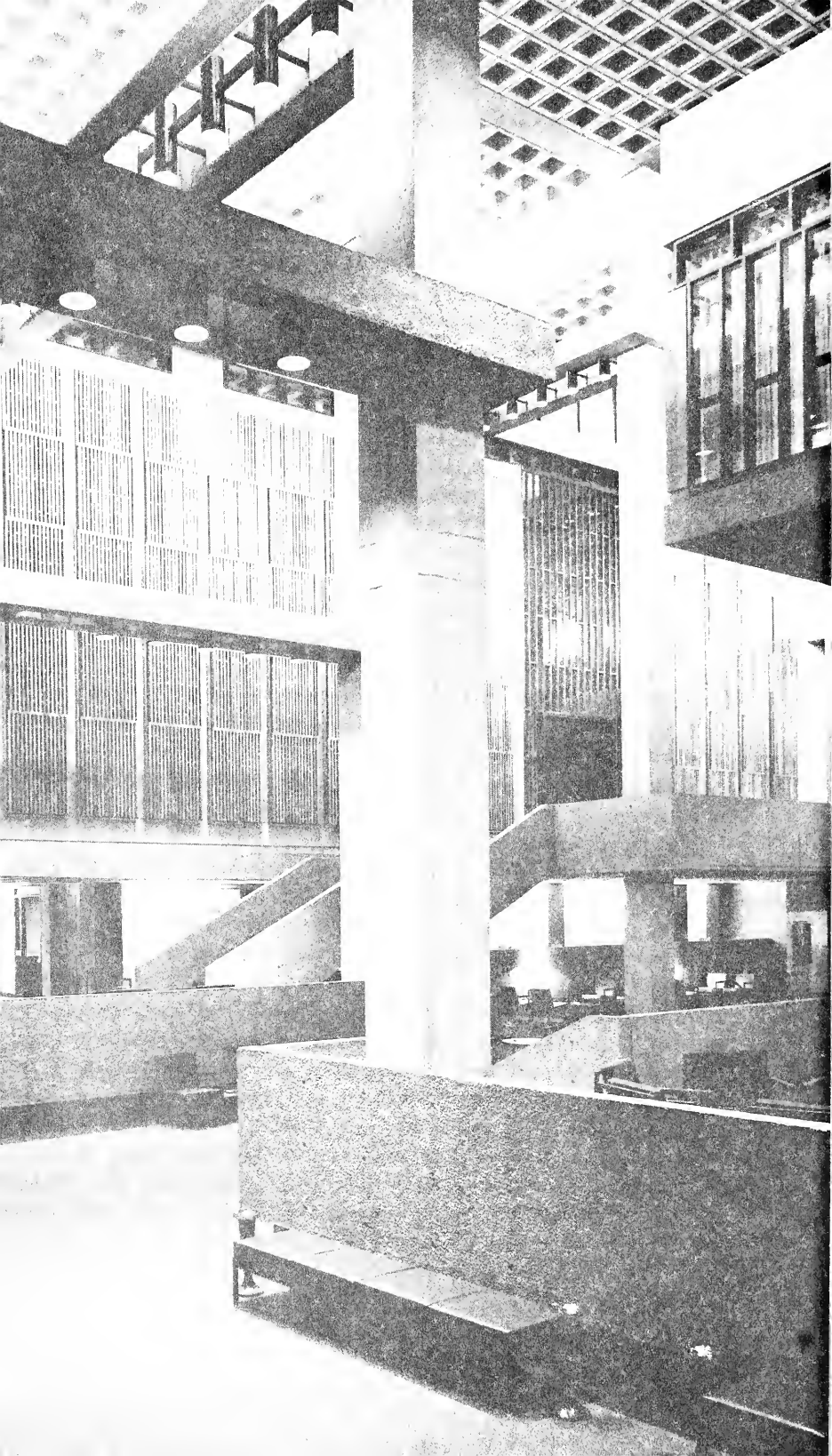
The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning take place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

## **DEPARTMENT OF GRADUATE PLACEMENT SERVICES**

Counseling and placement services are available to students and alumni of all University programs. A Job Bank of current opportunities located throughout Massachusetts and out of state is maintained, and individual counseling is available. For graduate students enrolled in programs operated on the Cooperative Plan, the Department makes possible an integration of academic work and professional experience in each field of concentration, by referring students to appropriate work assignments.

The Department also offers, on an ongoing basis, a seminar on the technology of job hunting, which teaches participants how to organize an effective job search. The seminar, which has received local and national media coverage in *The Washington Post* and *Newsweek* magazine, and on radio and television, discusses the techniques of building personal referral networks, conducting mail campaigns, and achieving successful interviews, as well as many other valuable tips. By offering the seminar and its other assistance, the Department provides a thorough and vital program of placement services.



# **buildings and facilities**

## **MAIN CAMPUS**

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intrastate lines, and MBTA subway-bus service within the metropolitan-suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 48 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## **Eli Student Center**

The Carl S. Eli Student Center provides facilities for student recreation and for extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the Center. Also included are special drama facilities, a ballroom main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

## **Libraries**

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Bur-

lington; the School of Law Library; and divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, Mathematics and Psychology, Health, Physical, and Recreation Education, and Physical Therapy. There are additional subject collections for the Center for Management Development in Andover, Massachusetts, and the Marine Science Institute in Nahant.

The library collections number 360,000 volumes supplemented by some 267,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,500 periodical titles, 90,000 documents, and 4,600 sound recordings.

### **Cabot Physical Education Center**

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. The large gymnasium contains four basketball courts. In addition, the Center consists of an athletic cage, a small gymnasium, and a rifle range, as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouvé College.

A recent addition to the Center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball courts, and shower and dressing facilities.

### **Dockser Hall**

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

### **Apartments for Graduate Students**

The University maintains a 100-apartment housing unit which accommodates 279 people. Two-, three-, and four-party apartments are available, which vary in size from two to four rooms plus bath. Apartments are furnished with beds, chairs, desks, stove, refrigerator, and kitchen table. The cost includes all utilities.

A \$50 deposit is required when making application for the apartments. Applications are available in the Office of University Housing. Students are expected to make such arrangements on a term-to-term basis, but may live in the apartments both while on cooperative work assignments and in school, if they wish. All reservations are made on a first come, first served basis.



## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, physics, mathematics, business administration, science, education, and the arts, portions of undergraduate programs leading to the associate and bachelor's degrees, special programs for adults, and noncredit state-of-the-art programs are offered.

### **Warren Center**

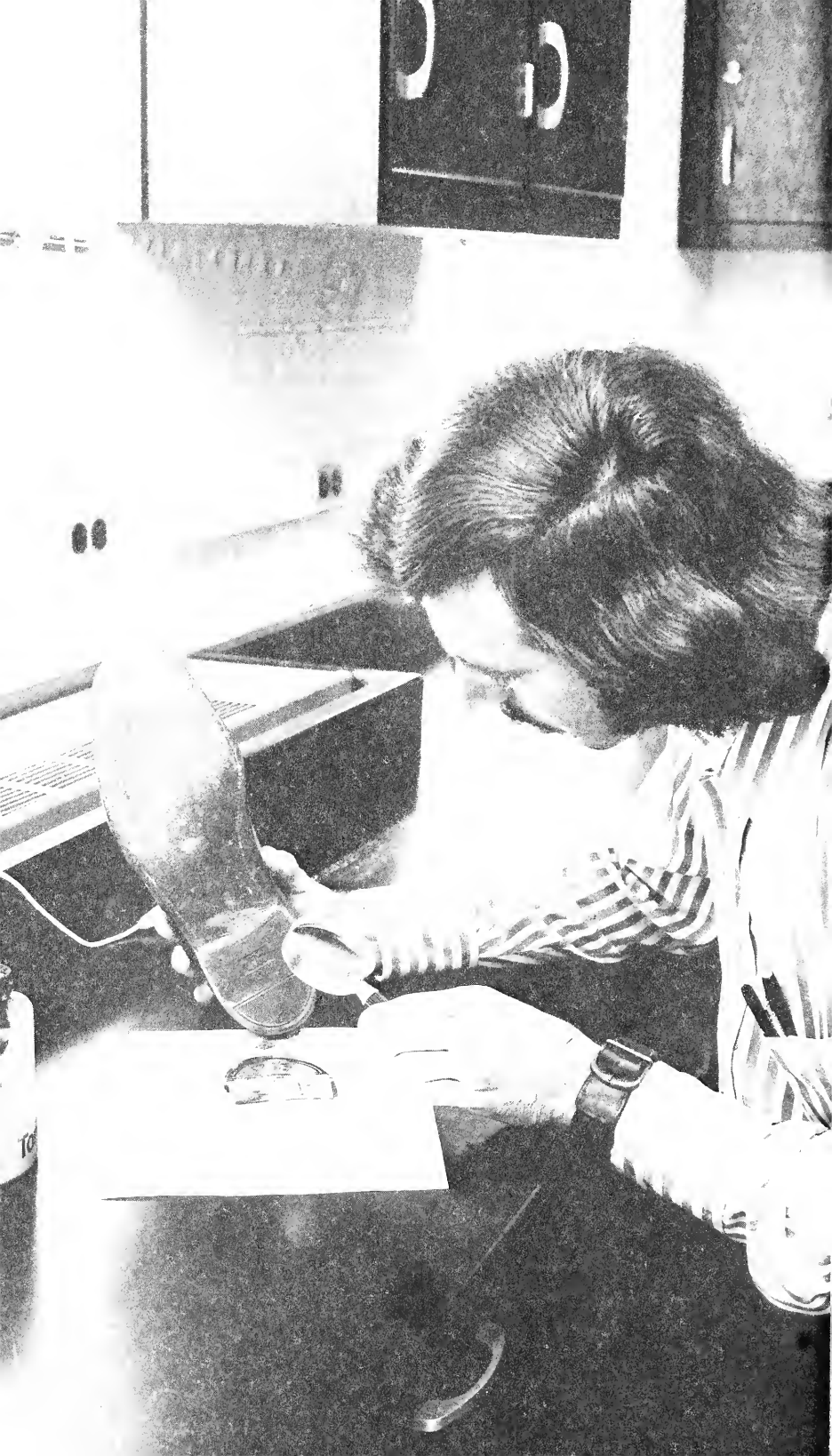
The Warren Center is a practical laboratory for Boston-Bouvé College in outdoor education and conservation, in group practicum, and in camping administration, programming, and counseling. At this Center in Ashland, completed in 1967, there are tennis courts, field hockey and lacrosse fields, waterfront for swimming and boating, overnight camp sites, fields and forests, heated cottages, and the Hayden Lodge with a recreation hall, library, crafts shop, dining facilities, and conference accommodations.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.

### **Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility engaged primarily in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at this institute are applicable toward an advanced degree in biology or health science.



# **college of criminal justice graduate program**

The Graduate Program in Criminal Justice at Northeastern University offers both a full- and part-time program leading to a Master of Science degree. Students have the opportunity to choose among three major concentrations of study: administration, policy development, and planning; behavioral science theory; and research. Development of leadership qualities is stressed in each specialization. The purpose of the graduate program is to provide innovative concepts in academic study and research of crime using the criminal justice process.

The master's program in criminal justice concentrates on the problem of crime as a form of deviant behavior through a system established in response to that problem. The multidisciplinary academic program emphasizes a systems approach to criminal justice, and stresses organizational and management theory. Broad in concept, the program is to be understood as encompassing such related disciplines as law, sociology, political science, psychology, criminology, and public administration. Its primary educational function is to prepare individuals for research, teaching, and administration within a changing criminal justice system.

Faculty members represent several academic disciplines. Teaching activities vary in nature and depend on the instructor's specific objectives. Specialized areas include courses in community treatment, delinquency, correctional management, criminology, and criminalistics.

The goals of graduate study in the College of Criminal Justice are:

1. To develop leaders capable of assuming responsibility for policy planning, administration, and group leadership.
2. To prepare individuals for criminal justice teaching positions in community colleges and other educational institutions.
3. To provide students with the necessary skills and knowledge for applied research and to facilitate their ability to discern problem areas.
4. To provide a foundation for advanced doctoral study.

### **FULL-TIME STUDY**

Graduate study in criminal justice may be pursued through either a full- or part-time program. Full-time study allows for completion of course work within one academic year, beginning in September and ending in June of the following year. A substantial portion of the full-time student's time is devoted to academic study. However, simultaneous work on the thesis is expected during this period. Most students finish the thesis requirement in one additional quarter, thereby completing the program within one calendar year.

### **PART-TIME STUDY**

Graduate study is also possible on a part-time basis. The part-time student is allowed to carry a maximum of two courses per quarter. Close consultation with a faculty adviser helps the part-time student determine a workable sequence of courses, and decide the number of credits to be carried each quarter. All degree requirements must be completed within five years from the date of enrollment.

### **GENERAL REGULATIONS**

The general regulations and minimum requirements for all graduate programs are established by the Northeastern University Graduate Council. In some matters the committee of each graduate school is allowed discretion to establish regulations within limits defined by the Council. The regulations and academic requirements which follow have been formulated in accordance with this general policy.

### **Application**

All applicants should address inquiries to the Graduate Program of Criminal Justice. Application forms and information will be mailed promptly.

## **Registration**

Students must register within the period listed on the school calendar. Registration is not permitted after this period.

## **Residence**

All work for advanced degrees must be completed in residence at the University, unless approval has been obtained from the Director of the Graduate Program in Criminal Justice for work taken elsewhere. Students who are in residence and using the facilities of the University must register for such work.

## **Grading System**

The performance of students in graduate courses is recorded by the instructor, using the following grades:

A Excellent

For performance of high graduate caliber

B Satisfactory

For performance at a satisfactory level

C Fair

For performance not at the level expected in graduate work

F Failure

For unsatisfactory performance

I Incomplete

For failure to complete course work

The designation "I" will be changed to a grade upon removal of the deficiencies which caused the "I" to be reported. Deficiencies must be removed within a period stipulated by the professor.

Any student who wishes to take a make-up examination must obtain permission from the professor teaching the course. A reasonable time period for the examination is discussed with and set by the professor.

## **Class Hours and Credits**

All credits at Northeastern University are entered as quarter-hour credits, with a quarter hour of credit being equivalent to three-fourths of a semester hour: i.e., 12 semester hours are equal to 16 quarter hours.

All classes in the Graduate Program in Criminal Justice meet on a quarter basis, with an academic quarter defined as a term of approximately 12 weeks' duration. The academic calendar in the front of this bulletin should be consulted to determine the opening dates of each quarter.

### **Continuity of Program**

Students are expected to maintain continuous progress toward a degree. Any student who does not attend Northeastern for a period of one year must apply for readmission.

### **Withdrawals**

In order to withdraw from a course, a student must fill out an official withdrawal form obtained at the Registrar's Office. Withdrawals may be made through the ninth class meeting of the quarter. Students will be withdrawn as of the date on which they complete the form. Ceasing to attend a class or notifying the instructor does not constitute an official withdrawal. Petitions for withdrawal from a course after the ninth class meeting of the quarter must be submitted to the Director of the Graduate Program, and may be approved to avert unusual hardships on the student.

Students who do not attend the first two sessions will be dropped from the class unless they notify the Registrar of their intention to continue.

### **Changes in Requirements**

The continuing development of the Graduate Program requires occasional revision of curricula. In every new bulletin, some improvements are indicated. When changes impose no hardships on the student and school facilities permit, the student is expected to meet the requirements of the latest bulletin. If the student finds it impossible to meet these requirements, the bulletin for the year in which he entered becomes the binding one.

### **Application for the Diploma**

If a commencement card is not filed with the Registrar's Office on or before the applicable date listed on the calendar, there is no assurance that the degree will be granted in that particular year, even though all other requirements have been fulfilled.

## **THE MASTER OF SCIENCE DEGREE**

### **Admission Requirements for Degree Candidacy**

All applications for graduate study in Criminal Justice are reviewed by the Graduate Admissions Committee and must include:

1. A completed application accompanied by a nonrefundable \$15 application fee.

2. Official transcript(s) from accredited institution(s) as evidence of earning a baccalaureate degree with a grade point average of approximately 3.0 or higher.
3. Official scores from the aptitude test of the Graduate Record Examination or Law School Aptitude Test; above-average scores are preferred.
4. Three letters of recommendation from academic, professional, or personal sources; academic references are preferred.
5. An essay of not more than 400 words which expresses academic and personal objectives.

No one factor is used to select candidates for the program. The Graduate Admissions Committee receives all applications and considers a variety of factors, including previous work experience and professional potential, in addition to academic record and test scores. When possible, students are asked to participate in an admissions interview to help the Committee make a complete evaluation.

Consideration for admission is given only after all application material, including the \$15 application fee, has been received by the Graduate Program in Criminal Justice.

### **Student Classifications**

Students whose credentials meet the criteria listed above are classified as full- or part-time regular students.

*Part-time provisional* students are individuals who did not meet admission standards but who, in the opinion of the Graduate Committee, have the potential for graduate work. Applicants for full- or part-time regular status whose credentials do not warrant acceptance are automatically considered for part-time provisional status.

Upon completion of 12 quarter hours of course work at Northeastern, the provisional student must request a transfer to regular student status in the Graduate Program. To be considered for transfer, 6 of the 12 credits must be from required courses offered by the Graduate Program in Criminal Justice with a grade of at least B. An overall cumulative grade average of B must be maintained in courses taken outside the College of Criminal Justice.

*Special students* may take courses on a nondegree basis only by obtaining permission from individual instructors. Should a special student desire admission to the degree program as a regular student, he/she must meet standard admission requirements. Up to 12 credits (no more than two courses per quarter) may be

taken as a special student before applying for admission. All courses must result in a grade of B or better; if 12 credits have been completed, 6 must be from required courses.

### **Academic Requirements for the Master's Degree**

All candidates for the Master's Degree in Criminal Justice are required to complete the following:

1. A total of 42 hours of course credit.
2. Thirty-six of the total 42 hours completed in classroom work, 18 of which are required courses and 18 elective courses.
3. Completion of an acceptable thesis valued at 6 credits.
4. Satisfactory performance on a comprehensive written examination. Full- and part-time students may apply to take the comprehensive examination when they have completed all course requirements.

Students in the program must earn a grade of B or above in all required and elective courses offered within the Graduate Program in Criminal Justice. An average of B or above is also required in all other elective courses taken within the University. Each student is expected to maintain an overall average of B or better in all course work to remain in the program.

Within the above limitations, a criminal justice required or elective course for which a grade of F is received, must be repeated with a grade of B or better, and may be repeated only once. If a grade of F is received in a University elective course, that course may be repeated once to obtain a grade of C or better, or another elective course may be substituted. If a grade of C is received in a required course, provisions may be made with the professor to correct the deficiency.

### **Program Selection**

Upon acceptance as a degree candidate, the student is assigned a temporary adviser in his/her major area of concentration. In consultation with his/her adviser, the student develops a program of study, including program objectives, anticipated courses, and estimated dates of completion of the various degree requirements. The temporary adviser also helps the student select a thesis committee which assists him/her in all academic matters, as well as in the development and completion of the thesis.

### **Transfer Credits**

Individuals who have been enrolled in other graduate degree programs, who have earned a graduate degree, or who have



taken graduate courses on a nondegree basis may be granted credit at the discretion of the Graduate Committee. A maximum of 12 quarter hours of credit from another institution is acceptable providing it meets specified requirements. Courses should be the equivalent of or comparable to courses offered in the Graduate Program in Criminal Justice. If accepted, each course represents 3 quarter hours of credit. A petition for transfer of credit, obtainable from the College of Criminal Justice, together with official transcripts and course descriptions from the institution(s) attended, must be provided before committee action will be taken.

### **Comprehensive Examination**

Each candidate takes a comprehensive examination no later than one month prior to the expected date of graduation. This examination may be taken when the candidate has completed all course requirements, as the subjects tested are commensurate with the student's area of concentration.

A grade of B or better must be achieved in the examination. A student who fails may be given a reexamination under conditions determined by the Director of the Graduate Program or his designate.

### **Thesis**

Each candidate must submit a thesis which exhibits his research ability and increases his scope of individual specialization. The thesis proposal is submitted for approval to the candidate's thesis committee: a chairman and one or two members proposed by the student. Once approved, the thesis committee serves as an advisory board on idea development. The completed thesis must be approved by the thesis committee, graduate committee, and Director of the Graduate Program.



# **financial information**

## **FINANCIAL OBLIGATIONS**

### **Tuition**

Tuition rates and fees are subject to revision by the Board of Trustees at any time. However, any change in tuition and fees will become effective at the beginning of the school year which follows the one in which the change was announced.

Tuition for master's degree candidates and special students is \$61 per quarter hour of credit.

Tuition statements are mailed to students by the Bursar's Office and are payable by check to Northeastern University on or before the date specified.

### **Fees**

All applications must be accompanied by a nonrefundable application fee of \$15. No application will be processed until the fee has been received by the Graduate Program in Criminal Justice. Checks should be made payable to Northeastern University and sent, with the application, to the Graduate Program in Criminal Justice, Northeastern University, 360 Huntington Avenue, Boston, Massachusetts 02115.

Other fees include a charge of \$10 for late payment of tuition and a fee of \$25 for all degree candidates, payable before commencement by the applicable date listed on the academic calendar.

Full-time students are charged \$12.50 per quarter for the services available in the Student Center; part-time students are charged \$.75 a quarter.

All financial obligations to the University must be discharged prior to graduation.

### **Refunds**

Tuition refunds are granted only on the basis of the date appearing on the official withdrawal form filed by the student. Non-attendance does not constitute official withdrawal. Questions regarding refunds should be discussed with the Bursar's Office.

Refunds will be granted in accordance with the following schedule:

Official Withdrawal Filed Within	Percentage of Tuition Refunded
First week of quarter	100
Second week	75
Third week	50
Fourth week	25

### **FINANCIAL AID**

There is a limited amount of financial aid for part-time students enrolled in the Graduate Program in Criminal Justice. Graduate assistantships and/or fellowships in the College are not available to part-time students. A limited number of research fellowships may be available to qualified full-time graduate students. Research fellows are selected on the basis of academic background, research potential, and a written research proposal. Assigned duties require 18-20 hours per week, for which the student receives a stipend of \$3450 per calendar year and a tuition waiver.

### **Martin Luther King, Jr. Scholarships**

A limited number of full- and part-time Martin Luther King, Jr. Fellowships are available. These scholarships provide for remission of tuition and all fees, and are awarded to qualified black students on the basis of financial need. Additional information and application forms are available from the Office of Financial Aid.

### **Dormitory Proctorships**

A number of proctorships in men's dormitories on or near the Huntington Avenue Campus are available each year. Appointments carry a minimum compensation of room and board. Further information and application forms may be obtained from the Office of University Housing.

## **National Direct Student Loan**

Under provisions of an act of the Federal government, students carrying an academic load of one-half or more are entitled to loans up to \$2,500 for one school year and up to a total of \$10,000 for undergraduate and graduate work. The actual amount of any award will be determined on the basis of need and academic promise.

The repayment period begins nine months after the borrower ceases to carry a half-time load and extends ten years from that point at an annual interest rate of three percent. Up to 100 percent may be cancelled for teachers in special education. Additional information and application forms are available from the Office of Financial Aid. The application deadline is September 1 for full-time students, and one month prior to the start of the quarter for which aid is requested, for other students.

## **Higher Education Loan Plan (Guaranteed Student Loan Plan)**

Educational assistance loans may be available from certain banks in the student's home town. These loans, guaranteed by state agencies, carry an interest charge of seven percent, three percent of which is paid by the Federal government. Graduate students may borrow up to \$2,500 for each year of study, up to a maximum of \$10,000 for both undergraduate and graduate work. Monthly repayment begins nine to twelve months after completion of study, and extends up to five years for amounts less than \$2,000 or up to ten years for amounts greater than \$2,000. Applicants for this loan are required to complete a need analysis form. Additional information and application forms are available from the Office of Financial Aid.

## **Law Enforcement Assistance Administration**

The Law Enforcement Assistance Administration, U.S. Department of Justice, has set up an Office of Academic Assistance under authority of the Omnibus Crime Control and Safe Streets Act of 1968, Public Law 90-351. Through the University, loans up to \$2,200 per year for tuition, and grants up to \$250 per academic quarter for tuition and fees are available to law enforcement personnel in undergraduate or graduate programs leading to degrees or certificates in areas directly related to law enforcement.

The loans, limited to full-time students in or preparing for law enforcement or corrections careers, are cancelled at the rate of 25 percent for each year the recipient subsequently serves in law enforcement at federal, state, or local level.

The grants are available to full-time or part-time students employed in a publicly-funded law enforcement agency, and involve a signed agreement to remain in the service of a law enforcement agency employing such applicant, for two years following completion of the course for which aid was given.

Applications for loans or grants should be obtained from the Office of Financial Aid, Room 252 Richards Hall.

**Please note: Aid granted from programs sponsored by the Federal government is dependent upon the amount of funds allocated to Northeastern. The University does not award financial assistance in any form to non-citizens of the United States.**

# faculty

## GRADUATE TEACHING FACULTY AND STAFF OF THE COLLEGE OF CRIMINAL JUSTICE

Ames, Lois, B.A., M.A., A.C.S.W. certified, *Assistant Professor of Criminal Justice*

Croatti, Robert, B.S., *Assistant to the Dean of Criminal Justice*

Cunliffe, Frederick, B.S., M.S., Ph.D., *Professor of Criminal Justice*

Deming, Romine, B.A., M.S., Ph.D., *Associate Professor of Criminal Justice*

Fuller, Robert, B.S., M.S., *Administrative Assistant, Graduate Program in Criminal Justice*

Flynn, Edith, B.A., M.A., Ph.D., *Associate Professor of Criminal Justice*

Gallati, Robert, B.S., L.L.B., L.L.M., D.J.S., *Professor of Criminal Justice*

Kassler, Haskell, B.A., J.D., *Assistant Professor of Criminal Justice*

Natoli, Richard, B.S., M.A., *Assistant Professor of Criminal Justice*

Reed, James, B.F.A., M.A., *Assistant Professor of Criminal Justice*

Rosenblatt, Norman, B.A., M.A., Ph.D., *Dean of the College of Criminal Justice, Director of the Graduate Program in Criminal Justice*

Schafer, Stephen, D. Jur., Prof. Agrégé, *Professor of Criminal Justice*

Senna, Joseph, B.A., M.S.W., J.D., *Associate Professor of Criminal Justice*

Sheehan, Robert, B.A., M.A., *Professor of Criminal Justice*

Siegel, Larry, B.A., M.A., *Assistant Professor of Criminal Justice*

Turek, Donna, B.A., M.A., *Assistant Professor of Criminal Justice*





# fields of study

## PROGRAMS IN PROFESSIONAL SPECIALIZATIONS

### Master of Science

The master's curriculum is divided into two categories of major concentration: (1) Criminal Justice Administration Planning and Development, and (2) Behavioral Science Theory and Research. Model and specimen programs for each concentration can be found on pages 39-41 in this bulletin. Students must choose one of the two concentrations and complete one of the programs outlined in the following pages.

#### Group I Core Curriculum (18-20 credits)

This group consists of all required graduate courses offered and taught by the faculty of the College of Criminal Justice. Core courses are taken by all students regardless of major concentration or elective interest. *Students interested in Behavioral Science Theory are required to take one additional core course, Juvenile Justice and Delinquency, making a total of 21 credits of core courses.* The core curriculum encompasses a broad area of topical information, and comprises a solid foundation for graduate study in criminal justice.

#### Course

Administration of Criminal Justice	3
Theories in Criminology	3
Legal Issues in Criminal Justice	3
Criminal Justice Planning and Development	3
Statistical Analysis	3
Research Methods in Criminal Justice	3
	<hr/>
	18 credits

cont.

## 42 / FIELDS OF STUDY

Juvenile Justice and Delinquency (TO BE TAKEN BY STUDENTS CONCENTRATING IN BEHAVIORAL SCIENCE THEORY)	<u>3</u> 21 credits
THESIS	<u>6</u> 27 or 24 credits
Elective Courses	<u>15</u> or 18
TOTAL PROGRAM	42 credits

### Group II

The following is a list of elective courses offered and taught by the faculty of the Graduate Program in Criminal Justice. These courses involve specific problems of crime and criminal justice, while the required courses are more general in nature and emphasize the comprehensive systems approach to criminal justice.

#### Course

Conflict Management in Criminal Justice	3
Deviance, Stigma, and Justice	3
Correctional Services in the Community	3
Penology	3
Juvenile Justice and Delinquency	3
Forensic Science	3
Research Methods II	3
Field Practicum	3

### Group III Elective Curriculum

Elective courses offered by and taught in the following graduate programs may be credited toward meeting degree requirements for the Master of Science in Criminal Justice:

Graduate School of Arts and Sciences  
Graduate School of Business Administration  
School of Law  
Graduate School of Professional Accounting  
Graduate School of Engineering  
Graduate School of Education  
Graduate School of Pharmacy and Allied Health Professions  
Graduate School of Boston Bouvé College

**MODEL PROGRAM****MASTER'S DEGREE PROGRAM IN CRIMINAL JUSTICE****QUARTER I**

<b>Course</b>	<b>Credits</b>
Administration of Criminal Justice	3
Theories in Criminology	3
Statistical Analysis	3
Criminal Justice Planning and Development	3
Total	<u>12</u>

**QUARTER II**

<b>Course</b>	<b>Credits</b>
Research Methods I	3
Legal Issues in Criminal Justice	3
Juvenile Justice and Delinquency	3
Elective	3
Total	<u>12</u>

**QUARTER III**

<b>Course</b>	<b>Credits</b>
Elective	3
Elective	3
Elective	3
Elective	3
Total	<u>12</u>

**SUMMARY**

	<b>Credits</b>
Thesis	6
Required Courses in Criminal Justice	21
Electives from Criminal Justice and University	<u>15</u>
TOTAL	42

**SPECIMEN PROGRAM I****MAJOR CONCENTRATION****Administration, Policy Development, and Planning****QUARTER I**

<b>Course</b>	<b>Credits</b>
Administration of Criminal Justice	3
Theories in Criminology	3
Statistical Analysis	3
Criminal Justice Planning and Development	3
Total	<u>12</u>

**QUARTER II**

<b>Course</b>	<b>Credits</b>
Research Methods I	3
Legal Issues in Criminal Justice	3
Criminal Justice Elective	3
Functions and Techniques of Public Management (22.874)	3
Total	<u>12</u>

**QUARTER III**

<b>Course</b>	<b>Credits</b>
Criminal Justice Elective	3
Criminal Justice Elective	3
Urban Sociology (21.885)	3
Organization and Administrative Theory (50.953)	3
Total	<u>12</u>

**SUMMARY**

	<b>Credits</b>
Thesis	6
Required Courses in Criminal Justice	18
Elective Courses in Criminal Justice	9
Elective Courses from University	9
TOTAL	<u>42</u>

**SPECIMEN PROGRAM II****MAJOR CONCENTRATION****Behavioral Science Theory and Research****QUARTER I**

<b>Course</b>	<b>Credits</b>
Administration of Criminal Justice	3
Theories in Criminology	3
Statistical Analysis	3
Criminal Justice Planning and Development	3
Total	<u>12</u>

**QUARTER II**

<b>Course</b>	<b>Credits</b>
Research Methods I	3
Legal Issues in Criminal Justice	3
Juvenile Justice and Delinquency	3
Personality and Social Structure (50.805)	3
or	
Operations Research for Criminal Justice	3
Total	<u>12</u>

**QUARTER III**

<b>Course</b>	<b>Credits</b>
Criminal Justice Elective	3
Criminal Justice Elective	3
Foundations of Social Theory (21.805)	3
or	
Research Methods II	3
Social Psychology I (19.920)	3
or	
Introduction to Data Processing	3
Total	<u>12</u>

**SUMMARY**

	<b>Credits</b>
Thesis	6
Required Courses in Criminal Justice	21
Elective Courses in Criminal Justice	6
Elective Courses from University	9
TOTAL	<u>42</u>

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# **courses**

## **DESCRIPTION OF COURSES**

All courses carry three quarter hours of credit unless otherwise specified.

### **92.904 Administration of Criminal Justice**

A description and analysis of the criminal justice process from prevention and arrest to release after incarceration. Concentration is on a systems approach to understanding criminal behavior. The philosophies, practices, and procedures of agencies responsible for the administration of justice are viewed and critical efforts made to deal with the effectiveness of different approaches to crime control.

### **92.907 Theories in Criminology**

The history and development of criminological theories from ancient to contemporary times. It examines the assumptions of theoretical models and relates them to the development of criminal policies. Psychological, sociological, and cultural theories underlying deviant criminal behavior are reviewed.

### **92.910 Nature and Extent of Crime**

An extensive examination of the nature and volume of crime in the U.S. and foreign countries. Course content includes types of crimes and offenders, geographic distribution of crime patterns, cost of crime, and a critical review of techniques used to measure crime.

### **92.913 Criminal Justice Planning and Development**

Introduction to planning techniques and their impact on criminal justice program development, now and in the future. Policy and decision-making procedures pertaining to affiliated agencies and organizations are analyzed. The extent of planning for crime control on local, state, regional, and national level is studied. The peculiar nature of urban crime problems in relation to planning is also reviewed. Planning involves identification of problem areas, diagnosing causation, formulating solutions, alternative strategies, and mobilizing resources necessary to effect change in the system.

### **92.916 Statistical Analysis**

An analysis of the application of statistics in research, and the basic assumptions underlying statistical procedures. The course covers descriptive and inferential statistical procedures such as sampling, laws of probability theory, hypothesis testing, analysis of variance, and multiple regression.

(Students with a background in statistics may make a special request to replace this course with an elective.)

### **92.957 Research Methods in Criminal Justice I**

Survey of methods and approaches utilized for independent research, as well as the evaluation of existing criminal justice programs. It considers research methods and empirical findings through assigned research techniques including design, instrument construction, data processing, and analysis interpretation.

### **92.958 Research Methods in Criminal Justice II**

Advanced research design problems are examined. Criminal justice programs are evaluated quantitatively, with concentration placed on coding, schedule construction, sampling theory, and statistical models measuring causation.

### **92.841 Criminal Law**

General principles of the criminal law, including the concept of responsibility for crimes, limitations on capacity, and basic elements of crimes. The sources and purposes of criminal law are analyzed, and different conceptions of crime and current law reform are discussed.



**92.800 Law Enforcement Practices**

This course involves a study of the current theory and practices in the field of law enforcement. Major problems which confront the law enforcement process are considered, as well as the methods now used by law enforcement agencies.

**92.804 Correctional Services in the Community**

An analysis of treatment and supervisory activities, including probation and parole for offender groups while in the community. There is a thorough exploration of community resources and services such as vocational rehabilitation, welfare services, mental health clinics, employment services, and legal aid. Effectiveness of community treatment is examined through case studies.

**92.810 Penology and Corrections**

This course deals essentially with the process of incarceration and the social structure of the prison community. Consideration is given to management, operation effects, and the effectiveness of different institutions. Modern correctional approaches and current rehabilitation practices are also discussed.

**92.816 Social Deviance**

Crime as a form of social deviance is studied through intensive reading of a wide range of sociological literature on deviant behavior and its relationship to crime. Included are relevant selections from Durkheim, Merton, Cohen, Goffman, Becker, Matza, Ohlin, and Schur.

**92.851 Juvenile Justice and Delinquency**

A study of the juvenile justice system from community concern to the subsequent disposition. The class analyzes juvenile and family court procedures and questions of jurisdiction. Various theories of delinquency developed from law, sociology, psychology, and related disciplines are also covered.

**92.822 Forensic Science**

The development of forensic science is summarized according to its effects on the criminal justice system. Lecture and laboratory work examine various ways the physical sciences contribute to the establishment of scientific criminal evidence. Designed primarily for students who plan to enter a profession requiring an understanding of criminalistics.

### **92.828 Field Practicum**

Field instruction in a criminal justice agency where the instruction may be given in administration, research, teaching, and/or related activities. Students have the opportunity to apply theoretical concepts in a practical, applied fashion by observing and contributing to the daily activities of operating agencies and organizations.

### **92.860 Conflict Management in Criminal Justice**

An examination of problems in conflict management. Concepts and definitions of social conflict, and comparisons between functional and dysfunctional conflict are explored. Inquiries into representative conflict management strategies and techniques are made, which afford the opportunity to relate general theory and research results to practical situations of criminal justice conflict management. A variety of heuristic techniques is anticipated, such as: scenarios, roleplaying, and use of audiovisual media.

### **92.809 Deviance, Stigma, and Justice**

Stigmatization is accurately defined as it is found to exist in different segments of our society. Its history in the United States is traced through examples of specific topics, such as: employment of ex-offenders, social acceptance of mental patients, ethnic discrimination, and homosexuality.

### **92.806 Conflicting Values and the Criminal Justice System**

An investigation of ideologies, institutions, and ethnic mores as they affect black values and reactions to the criminal justice system. Integration, rebellion, and institutionalization are subjects of discussion.

### **92.830 History of Police in the United States**

A review of the history of police activities in the United States, emphasizing black community relations. The study of previous policy provides a broad, revealing perspective from which to view contemporary departments. From this framework, the class analyzes societal expectations of the police.

### **92.808 Criminal Behavior, Psychiatry, and the Public**

An introduction to the field of psychiatric criminology which exam-

ines the known psychological sources of criminal behavior. Psychiatric concepts are applied to crime prevention, the examination and rehabilitation of the offender, and the legislative process.

### **92.862 Drug Abuse, Mental Health, and the Public**

An introductory course concerning drug abuse. The mental health and medico-legal aspects of the problem are emphasized by concentrating on the areas of prevention and rehabilitation, public attitudes on drug abuse, and drug abuse education.

### **92.905 Legal Issues in Criminal Justice**

An in-depth study of contemporary legal questions faced by criminal justice professionals. Emphasis is placed on constitutional problems, and the judicial review of administrative decisions made by criminal justice organizations. Topics to be considered are: selected provisions of the United States Constitution with particular emphasis on amendments 4, 5, 6, and 14; questions of electronic surveillance; right to counsel; line-up, bail, and right to speedy trial; sentencing; legal aspects of probation and parole; and prisoners' rights.

### **92.808 Criminal Behavior, Psychiatry, and the Public**

An introduction to the field of psychiatric criminology. Examines current knowledge of the psychological sources of criminal behavior and the application of psychiatric concepts to the area of crime prevention, the examination and rehabilitation of the offender, and the legislative process.

### **92.812 Management Issues in Law Enforcement**

An analysis of controversial issues confronting the law enforcement administrator in determining policy and directing procedures. Current and planning practices are critiqued from the standpoint of rapidly accelerating innovation and a changing value system.

### **92.811 Contemporary Problems in Corrections**

A seminar focusing on the current crisis facing the American correctional system. It is designed to provide the student with a working perspective on some of the most salient issues in the field today: to critically reexamine the important precepts for corrections which have heretofore been treated as given; to analyze

contemporary problems in the light of corrections relationship to the other components of the criminal justice system; to explore avenues to more effective ways to deal with alleged and convicted offenders. The theoretical focus and general perspective of the seminar is sociological.

### **92.801 The Ombudsman**

An examination of the concept of the ombudsman as an intervenor for justice. The ombudsman, as a government official to check on government, is an established post in several European countries, particularly Scandinavia. In this country ombudsmen have already appeared in such diverse institutions as hospitals, city halls, prisons, and universities, and a number of states have established ombudsman offices. It has been urged that ombudsmen are needed at the various levels of American government. Massachusetts considered two ombudsman bills in this session of the legislature: One would create the Office of Ombudsman for Corrections; the other would create the Office of Residential Care Ombudsman for the Commonwealth. In this course, the readings and lectures will be supplemented by the appearance of knowledgeable guest speakers if possible.

### **92.813 Correctional Administration**

Concentration is on a general systems approach to organizational design and management in corrections. The major focus of the course is on the application of the managerial process, which places emphasis on the organization's totality, regarding it as "an organized or complex whole." As such, the general system approach views an organization's subsystems as secondary in importance to the primary system, and as mutually interdependent, and holds, as axiomatic, that subsystems cannot be altered without affecting other subparts of the whole. It is the object of the course to critically examine the organization and administration of the "corrections system" within and among the various political jurisdictions of the United States; to analyze administrative practices; to determine those processes which may encourage, facilitate, and develop more effective, efficient, innovative, economical, and humane organizational systems in corrections.

### **92.815 Deviance and Criminal Justice**

A critical examination of existing theories about deviant behavior—crime, juvenile delinquency, substance abuse, mental illness, homosexuality, and prostitution—; how they are used as general-

ized ways to approach deviance, and their possible implications for the development of a more comprehensive, general theory of deviant behavior. The relationship of social control to deviance, from purely reciprocal societal reactions to deviance to social control as an independent or “causal” variable of various forms of individual and social deviation, will be explored.



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# 1976-1978



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# Academic and Service Buildings

Map Code	Bldg. Code
African-American Institute	I3
Barletta Natatorium	AF
Botolph Building	BN
Cabot Physical Education Center	BT
Cambers Hall	CB
Churchill Hall	CA
Cushing Hall	CH
Dana Research Center	CU
Dockser Hall	DA
Dodge Library	DK
Eli Student Center (Auditorium section)	DG
Eli Student Center (Student Lounge section)	EL
Forsyth Building	H8
Forsyth Building Annex	EC
Greenleaf Building	FR
Hayden Hall	FA
Hurtig Hall (Faculty Center)	GR
Knowles Center (Grzymish Hall section)	G7
Knowles Center (Volve Hall section)	H1
11 Leon Street	B6
15 Leon Street	KG
Mugar Life Sciences Building (Peabody Center)	F5
Parker Building	F5
Richards Hall	J3
Robinson Hall	J3
Stearns Center	G9
United Realty Building	G3
Dormitories	F7
115 Hemenway Street	H10
119 Hemenway Street	F4
153 Hemenway Street	H5
157 Hemenway Street	PA
163 Hemenway Street	RI
Kerr Hall	RB
Light Hall	ST
Melvin Hall	UR
106-122 St. Stephen Street	15
Smith Hall	A8
Speare Hall	A8
Stetson Hall East	19
Stetson Hall West	53
	57
	63
	63
	KH
	LH
	D10
	B7
	E8
	SS
	B8
	SH
	E7
	SE
	D7
	SW

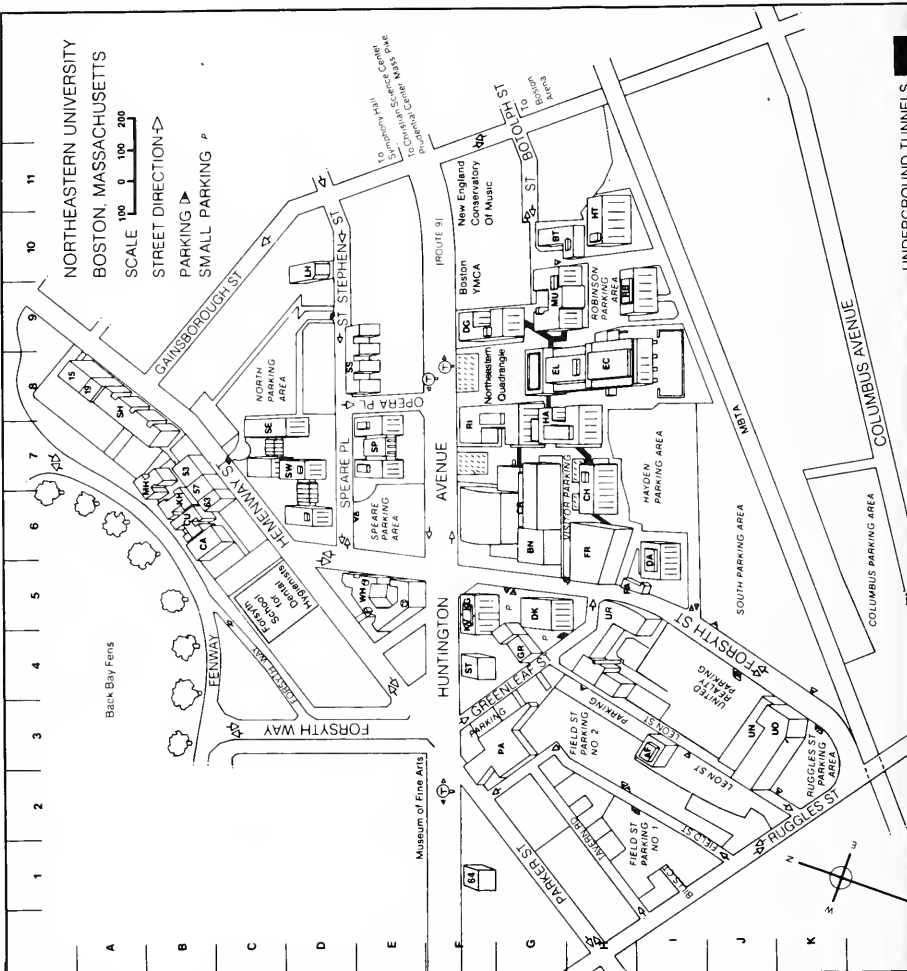
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## ACADEMIC CALENDAR 1977—1978

### Summer Quarter 1977

Registration period		
Burlington	Monday—Tuesday	June 13—14
Boston	Wednesday—Thursday	June 15—16
First-half classes begin	Monday	June 27
Last day to file card for		
Fall Commencement	Friday	July 1
Last day to pay fee for		
Fall Commencement	Monday	Aug. 1
Second-half classes begin	Wednesday	Aug. 3
Examination period	Wednesday—Thursday	Aug. 3—4

### Fall Quarter 1977

Registration period		
Burlington	Tuesday—Wednesday	Sept. 13—14
Boston	Monday—Thursday	Sept. 19—22
Classes begin	Monday	Sept. 26
Examination period	Monday—Saturday	Dec. 12—17

### Winter Quarter 1977—1978

Registration period		
Burlington	Tuesday	Nov. 29
Boston	Monday—Thursday	Dec. 5—8
Classes begin	Tuesday	Jan. 3
Examination period	Monday—Saturday	Mar. 20—25

### Spring Quarter 1978

Registration period		
Burlington	Tuesday	Mar. 7
Boston	Monday—Thursday	Mar. 13—16
Classes begin	Monday	Apr. 3
Examination period	Monday—Saturday	June 12—17

### Summer Quarter 1978

Registration period		
Burlington	Monday—Tuesday	June 12—13
Boston	Wednesday—Thursday	June 14—15
First-half classes begin	Monday	June 26
Second-half classes begin	Wednesday	Aug. 2

## UNIVERSITY HOLIDAYS 1977—1978

Columbus Day	Monday	October 10
Veterans' Day	Friday	November 11
Thanksgiving Recess	Thursday—Saturday	November 24—26
Christmas Vacation	Monday—Monday	Dec. 19—Jan. 2
Martin Luther King Day	Monday	January 16
Washington's Birthday	Monday	February 20
Patriot's Day	Monday	April 17
Memorial Day	Monday	May 29
Independence Day	Tuesday	July 4
Labor Day	Monday	September 4

## Equal Opportunity Policy

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees. Inquiries concerning our equal opportunity policies may be referred to the University Affirmative Action Officer and/or the Title IX coordinator.

## Delivery of Services

The University assumes no liability, and hereby expressly negates the same, for failure to provide or delay in providing educational or related services or facilities or for any other failure or delay in performance arising out of or due to causes beyond the reasonable control of the University, which causes include, without limitation, power failure, fire, strikes by University employees or others, damage by the elements and acts of public authorities. The University will, however, exert reasonable efforts, when in its judgment it is appropriate to do so, to provide comparable or substantially equivalent services, facilities or performance, but its inability or failure to do so shall not subject it to liability.

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Juanita Long

Melvin Mark

Frank E. Marsh, Jr.

John C. O'Byrne

Paul M. Pratt

Norman Rosenblatt

Albert H. Soloway

John A. Curry, *ex officio*

Roy L. Wooldridge, *ex officio*

### The Faculty Senate

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Samuel J. Bernstein

Charmarie Blaisdell

\*Philip T. Crotty

Robert S. Curtin

Ellen T. Daly

Ramona H. Edelin

Elaine G. Eliopoulos

Irene R. Fairley

Edith E. Flynn

M. Rita Flynn

Martha E. Francois

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Norbert L. Fullington

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Morton Loewenthal

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\*Melvin Mark

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Roy Weinstein

Karl Weiss

Alvin J. Yorra

*Presiding Officer*

Harry T. Allan

\*Appointed by the President

## **ORGANIZATION OF THE GRADUATE SCHOOLS**

### **Administration**

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Geoffrey P.E. Clarkson, B.S., M.S., Ph.D., *Dean of Business Administration*

Geoffrey Crofts, B. Comm., *Director of the Graduate School of Actuarial Science*

Philip T. Crotty, M.B.A., Ed.D., *Associate Dean of Business Administration*

Loretta Jean Davis, B.S., *Coordinator of Admissions, Graduate School of Education*

Stephen R. DeRosier, M.Ed., *Associate Registrar of the Graduate Schools*

Joseph M. Golemme, M.A., *Director of the Graduate School of Professional Accounting*

George W. Hankinson, M.S., *Director of the Graduate School of Engineering*

John W. Jordan, M.Ed., *Director of the Graduate School of Business Administration*

Thomas J. Kerr, M.S.I.E., *Assistant Director of the Graduate School of Engineering*

Robert H. Ketchum, Ph.D., *Director of the Graduate School of Arts and Sciences*

Paul M. Lepley, B.S., M.Ed., Ed.D., *Director of Boston-Bouvé College Graduate School*

John J. McKenna, M.A., *Assistant Director, Graduate School of Actuarial Science*

Thomas E. Moore, M.B.A., *Assistant Director of the Graduate School of Business Administration*

Norman Rosenblatt, Ph.D., *Director of the Graduate Program in Criminal Justice*

Philip J. Rusche, Ed.D., *Director of the Graduate School of Education*

Albert Soloway, Ph.D., *Director of the Graduate School of Pharmacy and Allied Health Professions*

Janice Walker, A.B., *Assistant Director of the Graduate School of Education*

### **University Graduate Council**

The Council determines broad policies and regulations governing the conduct of graduate work. All new graduate programs must be approved by the Council.

## **OFFICERS**

Harry Allan, *Chairman*  
Joseph Zelinski, *Vice Chairman*  
Joan Lipson, *Secretary*

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George W. Hankinson	Frank E. Marsh
Walter S. Jones	Norman Rosenblatt
John W. Jordan	Philip J. Rusche
Robert H. Ketchum	Albert Soloway
Paul M. Lepley	

### **Elected Faculty Members**

Petros Argyres	Harlan Lane
Joseph Barbeau	Robert Minichiello
Frederick Blanc	John Neumeyer
Conrad Caligaris	Irene Nichols
Carl Christensen	Robert Parsons
Austin Fisher	John Post
John Fox	Harold Raemer
Alberto Galmarino	Robert Read
M. Patricia Golden	Nathan Riser
Minton Goldman	Alae-Eldin Sayed
Bernard Goodwin	Joseph Senna
James Gozzo	Leon D. Shargel
Arlene Greenstein	Branch Sternal
Maurice Kaufman	Stanley Trachtenburg
Raymond Kinnunen	Elizabeth Van Slyck
Donald Kosersky	Joseph Zelinski
Louise LaFontaine	

### **Administrative Committee of the Graduate Schools**

Sidney Herman, *Chairman*  
Linda Allen, *Secretary*

Alvah K. Borman	Thomas Kerr
Geoffrey P.E. Clarkson	Robert H. Ketchum
Robert D. Croatti	Paul M. Lepley
Geoffrey Crofts	Alan A. Mackey
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Walter S. Jones	Thomas E. Moore
John W. Jordan	Edmund J. Mullen
John C. O'Byrne	Jacqueline A. St. Germain
Norman Rosenblatt	Ruthann Stiles
Philip J. Rusche	Janice Walker
Albert Soloway	

*Ex Officio*  
Harry T. Allan, *Provost*

**Committee of the Graduate School of Business Administration 1977-78**

Joseph M. Golemme, Co-chairman, *Professor of Accounting and Director of the Graduate School of Professional Accounting*

John W. Jordan, Co-chairman, *Associate Dean and Director of the Graduate School of Business Administration*

Geoffrey P.E. Clarkson, *Dean of the College of Business Administration*

Philip T. Crotty, *Associate Dean of the College of Business Administration*

Lal C. Chugh, *Associate Professor of Business Administration*

Victor B. Godin, *Associate Professor of Business Administration*

Richard B. Higgins, *Professor of Management*

Christine Hobart, *Associate Professor of Management*

Sitikantha Mahapatra, *Assistant Professor of Business Administration*

Robert J. Minichiello, *Professor of Marketing*

Thomas E. Moore, *Assistant Director of the Graduate School of Business Administration*

# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature by special enactment has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of nearly 180 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922); Liberal Arts (1935); Education (1953); Pharmacy (1962); Nursing (1964); Boston-Bouvé College (1964); the College of Criminal Justice (1967); and by Lincoln College's daytime Bachelor of Engineering Technology program (1971). This educational method enables students to gain valuable practical experience as an integral part of their college program and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses — offered by the University since 1906 — and adult-day courses leading to the bachelor's degree. In addition to offering day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The ten graduate and professional schools of the University offer day and evening programs leading to the degrees listed.

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.

The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science, with specialization in Physical Education or Recreation Education.

The Graduate School of Business Administration offers the degrees of Master of Business Administration.

The Graduate Program in Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degrees of Master of Education, Doctor of Education, and the Certificate of Advanced Graduate Study.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer degree, Doctor of Engineering, and Doctor of Philosophy.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

### **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established in 1960 to relate the University to the needs of its community in a period of accelerated change. Adult education programs offered by the Center and University College have since been consolidated. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

### **RESEARCH ACTIVITIES**

The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning take place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

# buildings and facilities

## MAIN CAMPUS

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intra-state lines, and MBTA subway-bus service within the metropolitan suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 48 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## Ell Student Center

The Carl S. Ell Student Center provides facilities for student recreation and for extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the Center. Also included are special drama facilities, a ballroom, main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

## Libraries

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Burlington; the School of Law Library; and divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, Mathematics and Psychology, and Health, Physical and Recreation Education, and Physical Therapy. There are additional subject collections for the Center for Management Development at Andover, Massachusetts, and the Marine Science Institute in Nahant.

The library collections number 400,000 volumes supplemented by some 333,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,700 periodical titles, 100,000 documents, and 4,600 sound recordings.

### **Cabot Physical Education Center**

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. The large gymnasium contains four basketball courts. In addition, the Center consists of an athletic cage, a small gymnasium, and a rifle range, as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouve College.

A recent addition to the Center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball courts, and shower and dressing facilities.

### **Dockser Hall**

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, physics, mathematics, business administration, sciences, education, and the arts, portions of undergraduate programs leading to the associate and bachelor's degrees, special programs for adults, and noncredit state-of-the-art programs are offered.

### **Warren Center**

The Warren Center is a practical laboratory for Boston-Bouv  College in outdoor education and conservation, in group practicum, and in camping administration, programming, and counseling. At this Center in Ashland, completed in 1967, there are tennis courts, field hockey and lacrosse fields, waterfront for swimming and boating, overnight camp sites, fields and forests, heated cottages, the Hayden Lodge with a recreation hall, library, crafts shop, dining facilities, and conference accommodations.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.

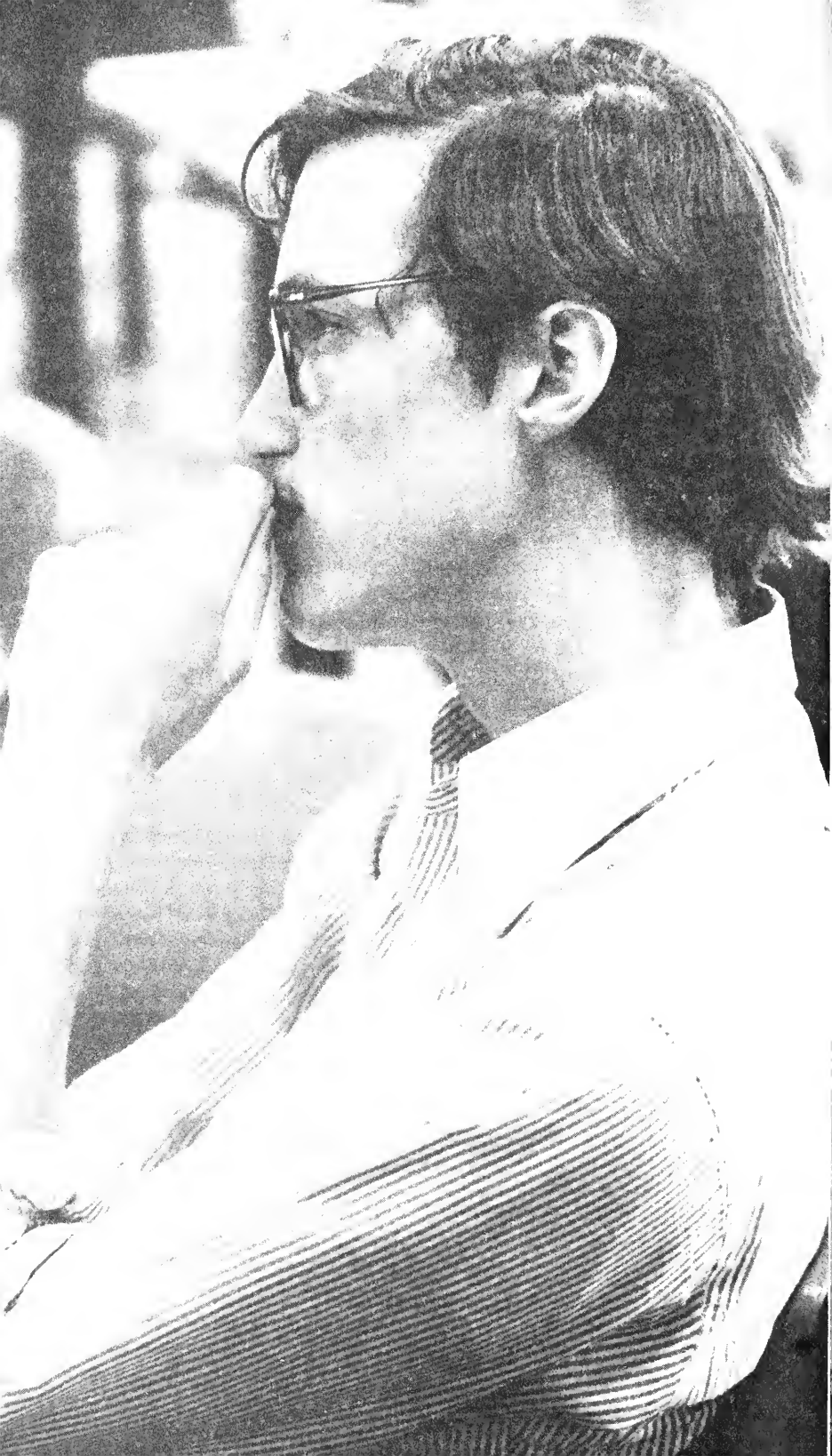


**Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility primarily engaged in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at this Institute are applicable toward an advanced degree in biology or health science.

**Nashua Campus**

Students residing in the Southern New Hampshire area may take a significant portion of the M.B.A. Program at facilities in Nashua, New Hampshire. These facilities, made available by Sanders Associates, Inc., are located in the company's headquarters on Route 3, just over the Massachusetts line.



# graduate school of business administration

The Graduate School of Business Administration at Northeastern University offers a program leading to the degree of Master of Business Administration. Broad in concept, the program is aimed at preparing the student for a career in administration rather than for an immediate or particular position. The curriculum and teaching methods center around the development of basic skills and knowledge appropriate to administration, rather than emphasizing specialized functional techniques. Although the case method of study is used extensively, a variety of teaching methods is employed that is consonant with particular course objectives. The basic objectives of the program are to increase skills and knowledge in basic disciplines underlying administrative practice, and to develop judgement and skills of problem analysis and decision making in complex organizations.

There is no prescribed undergraduate background recommended for admission. Undergraduate experiences typically include literature and the arts, mathematics and the sciences, and engineering and other applied fields. The program provides all managerial preparation appropriate to a graduate business curriculum. Flexibility allows for more intensive work in a specialized area or more general study in several fields to accommodate specific needs.

The student may choose one of three methods of securing an M.B.A. degree: internship, full-time, and part-time study.

## Internship

A feature which makes this Northeastern M.B.A. Program unusual in graduate education is the incorporation of a formalized work experience.

The 21-month program is in accordance with the Northeastern philosophy that a balanced exposure to theory and practice is the most effective approach to education. Class work begins with basic disciplines vital to sound progress in a management-oriented course. The functional areas of business are treated next, with process courses and electives following.

The Management Intern Program incorporates six months of full-time work experience in the world of business and 15 months of full-time classroom study. The intern student, after completing approximately one-half of the required M.B.A. course work, is employed in a capacity which provides both a realistic professional experience and an added source of funds for continuance in the program. The nature of the Intern assignment assures ample opportunity to apply concepts learned in the classroom and to test the realities of career options.

Because of economic, academic, and individual variables, the Graduate School doesn't guarantee placement; however, the University has full-time, experienced staff to assist the student in obtaining the internship. Students are also encouraged to investigate employment opportunities on their own in order to facilitate final placement by the intern coordinator.

Students are admitted as full-time interns in January and June of each year. The sequence of class and work sessions is illustrated below for both of these classes.

	<i>1st year</i>				<i>2nd year</i>				
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer
June class	Class	Class	Work	Work	Class	Class	Class		
January class			Class	Class	Work	Work	Class	Class	Class

During the first three academic quarters the student carries 18 quarter hours of credit; for the final two academic quarters the student carries 15 quarter hours of credit.

Thus, the full-time internship blends 15 months of academic study with six months of coordinated work in a business, industrial, or nonprofit setting. This combination of theory and practice gives the intern excellent preparation for a career in management.

### **Full-Time**

The full-time, non-internship allows students wide latitude in determining their pace toward the M.B.A. degree. Although most students take four courses each quarter, some take as many as five or six courses. This enables a candidate to complete degree requirements in a period from one calendar year to two academic years.

### **Part-Time**

Part-time students may continue their full-time employment while acquiring the background, skills, and knowledge that will help them advance their careers in administration.

These students normally take two courses per quarter; classes are scheduled so that part-time candidates may attend both courses on the same night. Therefore it is possible for a student to complete the degree program in three to four years, depending upon whether course work is taken during the summer quarter. All courses required for the M.B.A. may be completed at the Boston or Burlington campuses.

Students maintaining a satisfactory academic standing may petition the Director of the Graduate School of Business Administration for permission to take more than two courses per quarter.

Thus, part-time students have the advantage of attending classes in the late afternoon and evening to learn the theory behind the practical application of their employment.

**APPLICATION INFORMATION AND PROCEDURE**

All applicants should address inquiries to the Graduate School of Business Administration. Application forms and reference blanks will be mailed to them. This material, together with one official undergraduate transcript, the Graduate Management Admission Test (GMAT) scores, and the results of the Test of English as a Foreign Language (TOEFL, required by all applicants whose native language is not English), should be returned to:

Northeastern University  
Graduate School of Business Administration  
224 Hayden Hall  
Boston, Massachusetts 02115

Applications for the GMAT Examination can be obtained by writing to:

Educational Testing Service  
Box 966  
Princeton, New Jersey 08540

Applications for the TOEFL Examination can be obtained by writing to:

Educational Testing Service  
Box 899  
Princeton, New Jersey 08540

**DEADLINES FOR APPLICATION**

<b>Class</b>	<b>Full-Time Deadline</b>	<b>Classes Begin</b>
Assistantship	March 15th	4th week in September
Full-Time	April 1st	4th week in September
June Intern	April 1st	4th week in June
January Intern	October 15th	1st week in January

<b>Class</b>	<b>Part-Time Deadline</b>	<b>Classes Begin</b>
Winter	November 1st	1st week in January
Spring	February 15th	1st week in April
Summer	May 15th	4th week in June
Fall	August 1st	4th week in September

To be admitted for graduate work in the College of Business Administration, applicants must have completed undergraduate work of high quality and must have obtained a bachelor's degree from a recognized institution of higher learning. The overall quality of undergraduate achievement is considered to be of more importance than the particular field of specialization. Official transcripts of all previous undergraduate and graduate work

must be submitted to the Graduate School of Business Administration before admission can be considered or an evaluation made.

Personal interviews may be required for evaluation to the management intern program. Applicants will be invited to the Boston campus for an interview after all application material has been received.

Due to the rolling admissions policy of the Graduate School, applicants for the January intern program will not be granted interviews until July of the preceding year. Final decisions for the January class will be made beginning in August.

The basic criteria considered in the admissions procedure are: undergraduate grades, previous graduate work, the score on the GMAT, job experience, and present job level. An overall impression of strength, past success, and motivation to succeed in the Graduate School is sought in the applicants for the program.

Although the M.B.A. Program presumes no particular level of competence in the areas of accounting, economics, statistics, mathematics, and behavioral science, prospective applicants are advised to acquire some background in these areas in their undergraduate work.

### **GENERAL REGULATIONS**

The general regulations and minimum requirements for all graduate programs are established by the Northeastern University Graduate Council. In some matters the committee of each graduate school is allowed discretion to establish regulations within limits defined by the Council. The regulations and academic requirements which follow have been formulated in accordance with this general policy.

#### **Academic Requirements**

In order to qualify for the M.B.A. degree, an average grade of B must be obtained in the total credit hours required for graduation. No more than three extra courses or repeated courses may be taken in order to satisfy this grade requirement.

A student may not graduate with more than four course grades of C. Students accumulating more than four C's will have one quarter to clear the added deficiencies; no further course work will be permitted while these deficiencies are outstanding.

Within the above limitations, a required course for which a grade of F is received must be repeated during the next academic quarter with a grade of C or better, and may be repeated only once. If a grade of F is received in an elective course, that course may be repeated once with a grade of C or better, or another elective course may be substituted for it. If a grade of C is received in a required course, that course may be repeated once to obtain a grade of B or better.

The continuing development of the Graduate School forces frequent revision of curricula. In every new bulletin some revisions are indicated. When no hardship is imposed on the student because of changes, and when the facilities of the school permit, the student is expected to meet the requirements of the latest bulletin.

### **Application for the Degree**

A commencement card must be filed with the Registrar's Office before the date specified on the University calendar. This assures the student's graduation the same year all degree requirements are completed. Prompt filing of the commencement card also ensures the correct spelling on the diploma.

### **Continuity of Program**

Students are expected to maintain continuous progress toward a degree. Any student who does not attend Northeastern for a period of one quarter without notifying the program director will be classified as inactive.

All inactive students must submit a written petition to the director of the program in order to be readmitted to graduate study. Petition forms may be obtained in Room 224 Hayden Hall.

### **Credits and Class Hours**

All credits at Northeastern University are entered as quarter-hour credits, with a quarter hour of credit being equivalent to three fourths of a semester hour: i.e., 12 semester hours equal 15 quarter hours.

All classes in the Graduate School of Business Administration meet on a quarter basis, with an academic quarter defined as a term of approximately 12 weeks' duration. In the summer quarter, classes meet in two six-week sessions. The academic calendar at the front of this bulletin should be consulted to determine the opening dates of each quarter.

A minimum of 11 classes must be scheduled for each course during the fall, winter, and spring quarters. In a split summer session a minimum of 11 classes must be scheduled.

### **Grading System**

The performance of students in graduate courses will be recorded by the instructor through use of the following grades:

**A *Excellent***

This grade is given to those students whose performance in the course has been of very high graduate caliber.

**B *Satisfactory***

This grade is given to those students whose performance in the course has been at a satisfactory level.

**C *Fair***

This grade is given to those students whose performance in the course is not at the level expected in graduate work.

**F *Failure***

This grade is given to those students whose performance in the course is unsatisfactory.

In addition, the following letter designations are used:

**I** *Incomplete*

This grade is given to those students who fail to complete the work of the course.

The designation I will be changed to a grade upon removal of the deficiencies which caused the grade of I to be reported. Deficiencies must be made up within the quarter following that for which the grade of I is received, unless the instructor grants an extension of time. However, such extension may not exceed two additional consecutive calendar quarters.

## **Registration**

Part-time students must register during the periods listed on the school calendar. Dates of registration are specified by letter for students accepted for full-time study.

## **Residence**

All work for advanced degrees must be completed in residence at the University, unless approval has been obtained from the Director of the Graduate School of Business Administration for work taken elsewhere. Students who are in residence and are using the facilities of the University must register for such work.

## **Time Limitation**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years.

## **Transfer Credit**

A maximum of 15 quarter hours of graduate credit obtained at another institution may be accepted toward the master's degree, provided that the credits transferred carry grades of A or B, have been earned at a recognized institution, have not been used toward any other degree, and are relevant to the M.B.A. Program. Students should petition the Graduate School of Business Administration in writing for all transfer credit. Petition forms may be obtained in Room 224 Hayden Hall. Grades on transfer courses are excluded in the computation of the academic average necessary for the completion of the degree requirements.

## **Waiver Procedures**

Students with strong academic achievement in a specific course area may petition to waive required courses in that area. Although all petitions for course waiver must be initiated through the Graduate School office, each petition is subject to approval by the faculty within the particular academic area involved.



The faculty of each department has the authority to determine the adequacy of a student's background relative to the course material to be waived. Some departments may require examinations prior to waiver; others may dictate advanced electives to be taken in lieu of required courses successfully waived.

Generally several undergraduate courses in a specific area are required for a successful course waiver. The following guidelines also apply:

- A. No undergraduate course can be considered toward waiver request unless it was taken at an accredited school.
- B. No undergraduate course can be counted toward a waiver request unless a grade of "B" or better was received.
- C. No student shall receive the M.B.A. degree unless at least 18 graduate courses are taken within the Northeastern University graduate program.

Petition forms and waiver guidelines may be obtained in the Graduate School office (224 HA).

### **Withdrawals**

In order to withdraw from a course, a student must submit an official withdrawal form obtained at the Registrar's Office or at the Suburban Campus Main Office. Withdrawals may be made through the ninth class meeting of the quarter. Students are withdrawn as of the date on which they submit the form. Ceasing to attend a class or notifying the instructor does not constitute an official withdrawal.

Petitions for withdrawal from a course after the ninth class meeting of the quarter must be submitted to the Director of the Graduate School, and may be approved to avert unusual hardships on a student. Petition forms may be obtained in Room 224 Hayden Hall.



# financial information

## FINANCIAL OBLIGATIONS

### Tuition

1976-77 tuition for master's degree candidates and special students is \$66.00 per quarter hour of credit. Since each graduate course is three credit hours, the cost for each course is \$198.00.

Tuition statements are mailed to students by the Bursar's Office and are payable by check to Northeastern University on or before the date specified. Tuition rates and fees are subject to revision by the Board of Trustees at any time.

### Fees

All applications must be accompanied by an application fee (nonrefundable) of \$25.00. No applications will be processed until the fee has been received by the Graduate School of Business Administration. Checks should be made payable to Northeastern University and sent directly to the Office of the Graduate School of Business Administration, 224 Hayden Hall.

Upon notification of admission, all full-time applicants are required to pay a tuition deposit of \$100.00. Those accepted for part-time M.B.A. are required to pay a tuition deposit of \$50. These deposits are credited to the student's tuition, and are not refundable for those who do not register.

Other fees include: a charge of \$10.00 for late payment of tuition; and a fee of \$25.00 for all degree candidates, payable before commencement by the applicable date listed on the academic calendar.

For full-time students there is a charge of \$12.50 per quarter for the services available in the Student Center. The fee for tuition assistants, teaching assistants, and administrative assistants is \$6.25 each quarter. All part-time students on the Huntington Avenue Campus are charged \$.75 a quarter.

All full-time students will pay a nonrefundable University Health Services fee of \$120.00 each year. This fee provides Blue Cross-Blue Shield coverage and entitles the student to the medical care furnished by the University Health Services.

All financial obligations to the University must be discharged before graduation.

### Refunds

Tuition refunds are granted only on the basis of the date appearing on the official withdrawal form filed by the student. Nonattendance does not constitute official withdrawal. Questions regarding refunds should be discussed with the Bursar's Office.

Refunds will be granted in accordance with the following schedule:

<i>Official Withdrawal Filed Within</i>	<i>Percentage of Tuition Refunded</i>
First week of quarter	100
Second week of quarter	75
Third week of quarter	50
Fourth week of quarter	25

## FINANCIAL AID

The Graduate School of Business Administration grants financial aid only in the form of Assistantships. (Internships are available as part of the intern program.) Other forms of financial aid are not handled by the Graduate School but by the office indicated below.

### Assistantships

Students applying for the full-time M.B.A. Program are eligible to apply for the Graduate Assistantship Program. A separate Assistantship application must be filed with the Graduate School of Business Administration no later than March 15.

A full-time Assistantship enables students to pursue studies while serving in either (1) an administrative or (2) a teaching capacity within the College of Business Administration.

(1) Administrative Assistants assist staff or faculty in University administrative responsibilities. Positions available encompass functions in student counseling, college recruiting, curriculum scheduling, and application processing.

(2) Teaching Assistants are assigned duties in instructing classes, formulating and proctoring exams, and counseling students either in accounting, finance, marketing, statistics, or introduction to business.

Administrative and Teaching Assistants are expected to devote 20 hours per week to assigned duties. Appointments are made for each academic year, with full tuition remission, plus a stipend consisting of \$3,000 in the first academic year, and \$3,000 in the second. Tuition assistants are granted full tuition remission in return for 8 hours of service a week.

Applicants for the Teaching and Administrative Assistantships who are not selected for these awards will automatically receive consideration for a Tuition Assistantship with administrative or research responsibilities. (No additional application is required.)

Northeastern University, which is a member of the Council of Graduate Schools of the United States, subscribes to the following Resolution of the Council: "In every case in which a graduate assistantship, scholarship, or fellowship is offered to an actual or prospective graduate student, the student, if he indicates his acceptance before April 15, will have complete freedom through April 15 to submit in writing a resignation of his appointment in order to accept another graduate assistantship, scholarship, or

fellowship. However, an acceptance given or left in force after April 15 commits him not to accept another appointment without first obtaining formal release for the purpose."

### **Dormitory Proctorships**

A number of proctorships in men's dormitories on or near the Huntington Avenue Campus is available each year. Appointments carry a minimum compensation of room and board. Further information and application forms may be obtained from the Office of University Housing.

### **Guaranteed Student Loan Program**

Under this program, students who are matriculated degree candidates, enrolled for at least one-half the normal academic work load, may borrow from a participating bank or other financial institution. Terms and conditions vary from state to state, but a student generally may borrow up to \$1,500 a year (the law allows a maximum of \$2,500 per year) depending on financial need. The Federal government pays the interest while the student is in school if the student is eligible for interest subsidy.

The student must have submitted, through the College Scholarship Service, a Parents' Confidential Statement; or if he has been declared financially independent by the Financial Aid Office, a Students' Confidential Statement. These forms are available in the Financial Aid Office.

Applications for the loan itself are available from local banks or the Education Office of your state government. Additional information and necessary application forms for Massachusetts residents are available from the Financial Aid Office.

### **Martin Luther King, Jr., Fellowships**

A limited number of full-time Martin Luther King, Jr., Fellowships are available. Holders of these appointments devote full time to graduate work. Further information is available at the African-American Institute.

### **National Direct Student Loan**

This program is available to students who are carrying at least one-half the normal academic work load, are accepted as degree candidates, and who show evidence of financial need.

The Federal maximum which a graduate student may borrow while pursuing a post-baccalaureate degree is \$5,000.

Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load at an institution of higher education. The repayment of principal may be extended over a 10-year period with the interest at the rate of three percent per annum. Repayment may be deferred up to a total of three years while a borrower is serving as a Peace Corps or VISTA volunteer.



# faculty

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# master of business administration curriculum

Candidates entering the M.B.A. Program after January 1, 1977 must satisfy the requirements for 28 graduate business courses. Of these 28, there are 20 required courses and 8 electives. Those students entering the program with previous business education may apply for a maximum of 10 course waivers. However, most undergraduate business programs will qualify a candidate for no more than 4 to 6 waivers.

## Required Courses

<i>Number</i>	<i>Courses</i>	<i>Credit Hours</i>
41.811	Financial and Managerial Accounting .....	3
41.812	Control I .....	3
41.813	Control II .....	3
43.811	Marketing Management I .....	3
43.812	Marketing Management II .....	3
44.811	Financial Management I .....	3
44.812	Financial Management II .....	3
45.805	Operations Management I .....	3
45.806	Operations Management II .....	3
45.815	Behavioral Concepts .....	3
45.816	Organizational Behavior I .....	3
45.817	Organizational Behavior II .....	3
45.834	Policy: Environmental Analysis .....	3
45.836	Policy: The Formulation of Strategy .....	3
45.837	Policy: The Implementation of Strategy .....	3
49.901	Managerial Economic Analysis I .....	3
49.902	Quantitative Analysis I .....	3
49.903	Quantitative Analysis II .....	3
49.909	Managerial Economic Analysis II .....	3
49.932	Introduction to Computer Applications .....	3
Total Required Credit Hours .....		60
Elective Credit Hours .....		24
Total Credit Hours for Degree .....		84

## Elective Courses

In addition to the required courses, students must complete course work in electives to bring their total program to the 84 quarter hours of credit required for the Master of Business Administration degree. All elective

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courses carry three quarter hours of credit unless otherwise specified.

Courses may also be selected from other graduate programs at North-eastern University with the permission of the director of the appropriate program and the Director of the Graduate School of Business Administration.

The electives offered in the Graduate School of Business are continually being revised to conform to the interests of the Faculty and current student body. The courses listed below are representative in nature, having been offered during the last academic year.

### Administration and Its Environments

- 39.805 Business Cycles and Forecasting
- 39.823 Government Finance
- 39.825 Fiscal Policy
- 39.835 Labor Economics
- 39.9T5 Capital Markets
- 41.821 Accounting Problems for Decision-Making
- 41.862 Tax Factors in Business Decisions
- 45.821 Policy Formation in Non-Business Institutions
- 45.840 Managerial Styles and Sex Stereotypes
- 45.843 Environmental Pressures and the Multi-National Corporation
- 45.969 Government and Business
- 45.973 New Sectors of Collective Bargaining
- 45.991 Business Law—Law of Contracts, Agency, and Sales
- 45.992 Law of Business Organizations and Negotiable Instruments
- 49.908 Mathematics for Managerial Decisions

### Financial Management

- 44.814 International Financial Management
- 44.816 The Management of Financial Resources
- 44.818 Working Capital Management
- 44.901 Finance III—Advanced Financial Management
- 44.921 Investment Analysis
- 44.924 Mergers and Acquisitions
- 44.935 Management of Financial Institutions

### General Management

- 45.997 Special Studies in Business Administration (1 Q.H.)
- 45.998 Special Studies in Business Administration (2 Q.H.)
- 45.999 Special Studies in Business Administration (3 Q.H.)

### Health Care Administration

- 21.840 Sociology of Medicine
- 41.817 Fiscal Planning, Budgeting, and Control of Health Care Institutions
- 45.833 Operations Management in the Health Care System
- 45.838 Policy Formation in Health Care
- 45.841 Public/Private Service Systems
- 45.975 Introduction to Health Care Systems
- 45.976 Workers in the Health Care System
- 45.977 Information Systems for Health Care Facilities

### Management of Human Resources

- 45.819 Interpersonal Behavior
- 45.823 Career Planning and Development
- 45.824 Organizational Behavior in a Non-Profit Environment
- 45.835 Seminar in Organizational Development
- 45.951 Executive Development
- 45.971 Personnel Management
- 45.972 Labor Relations
- 45.993 Labor Law

**International Business Management**

39.833	International Economics
43.910	International Marketing
44.814	International Financial Management
45.843	Environmental Pressures and the Multi-National Corporation
46.810	Managing the Multinational Enterprise

**Management of Transportation and Distribution**

48.801	Intercity Transportation
48.805	Urban Transportation
48.901	Transportation and Corporate Distribution

**Managerial Control**

41.825	Management Performance Appraisal
41.862	Tax Factors in Business Decisions

**Small Business Management**

45.829	New Ventures: A Career Choice
45.965	Management of Small Business Enterprises
45.968	Management of New Enterprises

**Marketing Management**

43.814	Consumer Behavior
43.910	International Marketing
43.925	Sales Management
43.930	Statistical Analysis with Marketing Applications
43.931	Marketing Research
43.934	New Product Development
43.936	Retail Management
43.937	Marketing Public Goods and Services
43.941	Industrial Marketing

**Operations Management**

45.809	Advanced Operations Management
45.813	Operations Management in the Service Sector
45.831	Operations Management Policy
45.833	Operations Management in the Health Care System
45.902	Planning and Control of Manufacturing Operations
45.965	Management of Small Business Enterprises

**Computer and Information Systems**

49.918	Information Theory and Systems
49.933	Management Information Systems
49.935	Computer Applications in Management Science

**TWENTY-ONE MONTH COURSE SEQUENCE  
FOR MANAGEMENT INTERN STUDENTS**

<i>Quarter</i>	<i>Number</i>	<i>Course</i>
1	45.815	Behavioral Concepts
	45.816	Organizational Behavior I
	41.811	Financial & Managerial Accounting
	41.812	Control I
	49.932	Introduction to Computer Applications
2	43.811	Marketing Management I
	45.805	Operations Management I
	45.806	Operations Management II
	44.811	Financial Management I
	44.812	Financial Management II
	49.901	Managerial Economic Analysis I
3	49.902	Quantitative Analysis I
		Work Period
4		Work Period

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5	49.903	Quantitative Analysis II
	45.834	Policy: Environmental Analysis
	43.812	Marketing Management II
		Elective
6		Elective
	41.813	Control II
	45.817	Organizational Behavior II
	49.909	Managerial Economics II
7		Elective
	45.836	Policy: Formulation of Strategy
	45.837	Policy: Implementation of Strategy
		Elective
		Elective
		Elective

## RECOMMENDED PART-TIME PROGRAM FOR STUDENTS ENTERING AFTER JANUARY 1, 1977

<i>Quarter</i>	<i>Number</i>	<i>Course</i>
1	45.815	Behavioral Concepts
	45.816	Organizational Behavior I
2	41.811	Financial and Managerial Accounting
	49.901	Managerial and Economic Analysis I
3	41.812	Control I
	49.902	Quantitative Analysis I
4	49.903	Quantitative Analysis II
	49.932	Introduction to Computer Applications
5	43.811	Marketing Management I
	44.811	Financial Management I
6	43.812	Marketing Management II
	44.812	Financial Management II
7	45.805	Operations Management I
	49.909	Managerial Economic Analysis II
8	45.806	Operations Management II
		Elective
9	45.817	Organizational Behavior II
		Elective
10	41.813	Control II
		Elective
11	45.834	Policy: Environmental Analysis
		Elective
12	45.836	Policy: The Formulation of Strategy
		Elective
13	45.837	Policy: The Implementation of Strategy
		Elective
14		Elective
		Elective

**TRANSITION INSTRUCTIONS FOR CURRENT STUDENTS**

M.B.A. candidates who began the program before January 1st, 1977 must fulfill the degree requirements established at the time of their enrollment. For most current students, this means the completion of 24 graduate business courses.

The recommended sequence of courses for part-time students enrolled before January 1, 1977 is listed below.

**Recommended Part-Time Program for Current Students**

There can be some flexibility in the method of progression of the part-time student, but there is listed below the suggested sequence which is designed to accommodate most part-time students. Based on a program of two courses per quarter and with the student taking courses three quarters per year (summers excluded), all degree requirements will be completed in four years.

<i>Quarter</i>	<i>Number</i>	<i>Course</i>
1	41.811	Financial and Managerial Accounting
	45.815	Behavioral Concepts
2	41.812	Control I
	45.816	Organizational Behavior I
3	49.932	Introduction to Computer Applications
	49.902	Quantitative Analysis I
4	49.901	Managerial Economic Analysis
	49.903	Quantitative Analysis II
5	43.811	Marketing Management I
	44.811	Financial Management I
6	43.812	Marketing Management II
	44.812	Financial Management II
7	45.805	Operations Management I
		Elective
8	45.806	Operations Management II
		Elective
9	45.836	Policy: The Formulation of Strategy
	45.817	Organizational Behavior II
10	45.837	Policy: The Implementation of Strategy
	41.813	Control II
11		Elective
		Elective
12		Elective
		Elective

**OTHER GRADUATE-LEVEL PROGRAMS IN BUSINESS****The Center for Management Development****Management Workshop**

The Management Workshop is designed chiefly for middle managers who have demonstrated the potential for promotion into higher organizational

levels. It provides a comprehensive outline of the major areas of business through graduate-level courses in organizational behavior, financial analysis and control, operations management, marketing, and economic forecasting.

Classes in four subjects are scheduled for each of twelve Fridays from 8:30 a.m. to 5:00 p.m. at Northeastern's Henderson House Conference Center in Weston, Massachusetts. There is a choice of two sessions per year. The fall session begins the third Friday in September and ends in mid-December; the spring session starts the first Friday in March and continues twelve consecutive Fridays through mid-May.

### **Management Development Program**

The Management Development Program is a graduate-level course in business, designed for experienced managers who have had responsibility for a major task, function, department, division, or independent enterprise. Its general aim is to improve the manager's overall performance.

There is a choice of two six-week sessions spaced over five months, October through February or January through May. Participants attend two consecutive weeks of classes at the outset and thereafter one week in each of the remaining four months. This approach offers a tested alternative to organizations which recognize the need for manager training but find it difficult to release a key man for lengthy periods of study. A certificate is awarded to all who successfully complete the course work.

### **Graduate School of Professional Accounting**

The Graduate School of Professional Accounting offers a 15-month program for non-accounting majors that leads to the degree of Master of Science in Professional Accounting. This unique program combines 12 months of class work with a three-month internship in a public accounting firm.

Information may be obtained by writing to:  
Graduate School of Professional Accounting  
206 Hayden Hall  
Northeastern University  
Boston, Massachusetts 02115

### **The Program for Advanced Study in Business Administration**

The Program for Advanced Study in Business Administration has been instituted through the Graduate School of Business Administration. The main objective is to provide advanced work in business administration to meet the needs of a rapidly changing environment. Anyone who holds an M.B.A. or its equivalent is eligible. For further information contact the office of the Graduate School of Business Administration.

# description of courses

## **21.840 Sociology of Medicine**

Social aspects of illness and medicine, historically and cross-culturally, illness and the medical profession in modern society and their structural settings: the community, the hospital, the medical school. Research studies in the field will be examined critically and problems for future research will be specified.

## **30.9R3 Writing for the Professions**

This course shall consider general writing problems and those posed by particular professional responsibilities. *Prep. 15 Q.H. of Grad. Credit.*

## **39.805 Business Cycles and Forecasting**

Analysis of positive and negative characteristics of modern capitalism followed by a presentation of short- and long-run problems of economic and financial instability. Dynamic models of economic fluctuations, development of economic indicators, and survey data are used to understand the problem of forecasting. An evaluation of conceivable stabilization policies and programs is included. *Prep. 15 Q.H. Grad. Credit.*

## **39.823 Government Finance**

A survey of governmental expenditure, revenue, and debt systems, with emphasis upon their economic effects and their relationship to principles of economic welfare. Discussions of taxation, tax incidence, tax theory, debt management, and employment levels. *Prep. 15 Q.H. of Grad. Credit.*

## **39.825 Fiscal Policy**

Development of a conceptual framework to assess the impact of government policies on attaining full employment, price stability, economic growth, and other economic goals of the public sector. Special emphasis is given to conflicts resulting from simultaneously trying to achieve all goals while combating the problems of inflation and stagnation. *Prep. 15 Q.H. of Grad. Credit.*

## **39.833 International Economics**

Four areas, history, theory, policy and doctrine, are considered in relating the United States to the rest of the world, with emphasis on theory and policy. A study of money, gold- and/or paper-currency, in international trade and capital movements and the balance of payments, is combined with evaluated proposals for international monetary system reforms and other trade agreements recommending more cooperation and integration. *Prep. 15 Q.H. of Grad. Credit.*

## **39.835 Labor Economics**

The economics of wage determination, impact of unions on wages and inflation, the economics of full employment and unemployment, and private and public remedial policies; the labor force, governmental labor legislation, security, unionism, and democracy. *Prep. 15 Q.H. of Grad. Credit.*

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### **39.9T5 Capital Markets**

Primary courses of savings and demand for financial assets; role of financial intermediaries; banking system and government lending agencies. Demand for funds and real investment — mortgage, corporate and government securities markets; interdependence of rate structures. Flow of funds data in relation to national income accounts. *Prep. 15 Q.H. of Grad. Credit.*

### **41.811 Financial and Managerial Accounting**

An introduction to accounting systems, including the development of financial statements. Includes a critical appraisal of analytical techniques of evaluating the firm's potential through historical data. *Prep. none.*

### **41.812 Control I**

After examining the role which profit maximization plays as an entity objective, alternative courses of action for goal achievement are integrated into a programmed budgeting process. Emphasis is given to the budget as a planning, motivating, coordinating, evaluating, and re-planning device. *Prep. 41.811.*

### **41.813 Control II**

A study of the integration and coordination of short-range programs with long-range plans and the control mechanisms which enhance appropriate conformance with the strategic budget. Primary emphasis is on organizations decentralized into divisional units. *Prep. 41.812.*

### **41.817 Fiscal Planning, Budgeting and Control of Health Care Institutions**

Deals with financial planning, budgeting and control by studying: fiscal organizations, short and long range financial planning, impact of government regulations, financial reporting, cash flow analysis and forecasting, third party reimbursement and capital financing, all within traditional and emerging health care institutions. *Prep. 15 Q.H. or permission of faculty.*

### **41.821 Accounting Problems for Decision-Making**

This course is designed to extend the accounting knowledge of the M.B.A. student beyond the work of the core sequence in the accounting area. The approach is a study of contemporary accounting problems with both managerial and financial implications. These include: (a) lease vs. buy, and proper reporting procedures; (b) the implications of inflation, foreign operations, and tax regulations; (c) human resources accounting, especially pension and other benefit plan costs; and (d) the impact of segmental reporting. *Prep. 41.811, 41.812.*

### **41.825 Management Performance Appraisal**

A critical examination of traditional management appraisal, as well as recently proposed techniques. External appraisal of aggregate management performance and internal appraisal of individual management performance are covered. *Prep. 41.812.*

### **41.862 Tax Factors in Business Decisions**

A survey of the Internal Revenue Code and its implications for choice of organizational form, corporate reorganizations, compensation policies, and foreign business operations. Mergers and acquisitions and the management of depreciable property are examined in the light of decisions made by the Internal Revenue Service



and the tax courts. The emphasis is on discussion and research into corporate income tax problems that affect business decisions. *Prep. 15 Q.H. of Grad. Credit.*

#### **43.811 Marketing Management I**

The objectives of Marketing Management I and II are twofold: 1. to provide the student with a comprehensive understanding of basic marketing functions, institutions, and concepts; and 2. to develop the student's ability to analyze and make recommendations about business problems that involve the creation, distribution, and sale of goods and services. Marketing Management I emphasizes the definition of marketing problems, demand analysis, consumer analysis, and market research. *Prep. none.*

#### **43.812 Marketing Management II**

A continuation of Marketing Management I, with emphasis on the formulation and implementation of marketing strategy. Emphasis is placed on product policy, channels of distribution, pricing, advertising, personal selling, and the development of integrated marketing programs of action. *Prep. 43.811.*

#### **43.814 Consumer Behavior**

Development of an understanding of consumer attitudes and behavior processes. Various economic and behavioral models of consumer behavior are examined and evaluated as bases for the planning and evaluation of marketing strategies. Text, readings, project. *Prep. 43.811.*

#### **43.910 International Marketing**

Objective is to develop an understanding of: 1. the opportunities and challenges facing the international marketing executive; 2. the decision-making process in marketing goods abroad; and 3. the environmental forces—economic, cultural and political—affecting the marketing process and acting as constraints on the development of marketing strategies abroad. Lectures, discussions, reports, and cases. *Prep. 43.811.*

#### **43.925 Sales Management**

Designed to help the student develop both the understanding and decision-making skills necessary to build and maintain an effective sales organization. Cases and readings are used which examine the strategic and operating problems of the sales manager. Four major topic areas are: 1. the selling function, 2. sales management at the field level, 3. the sales executive, and 4. sales and marketing management. *Prep. 43.812, or permission of the instructor.*

#### **43.930 Statistical Analysis with Marketing Applications**

The purpose of this course is to introduce students to some of the multivariate statistical techniques that have been used in the analysis of consumer survey data. Both theory and applications will be discussed. While most applications will be in the marketing area, illustrations will also be given in order to show how the methods presented can be used in other areas such as jury selection, politics and public policy decisions. Topics to be covered will include (1) Design and Analysis of Experiments, (2) Regression Analysis, (3) Discriminant Analysis and (4) Non-Parametric Statistics. *Prep. 49.902, 43.811 or consent of instructor.*

#### **43.931 Marketing Research**

Major methods and techniques of marketing research are examined to understand

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the function of research in marketing decision making. Specific topics include research design, determination of information requirements, data collection methods, experimentation, sampling, data analysis, and use of the canned program. *Prep. 43.811 and 49.902.*

### **43.934 New Product Development**

The importance of new products to the survival and prosperity of firms continues to grow with increasing shortening of product life cycles; with changes in technology, competition, and consumer tastes; and with increasing operating costs. For most firms, coping with the problems of environmental change through modification of the product line is both vital and difficult. This seminar will have as a primary concern the examination and analysis of some of the problems firms face in directing and managing their new product development activities. *Prep. 43.812.*

### **43.936 Retail Management**

Examines selected major strategy problems facing large-scale food and general merchandise distributors; selects store locations; determines merchandising and promotional policies; and formulates long-range plans. Cases and issues are explored from the viewpoint of the management of prominent supermarket, department store, and discount retailers, with some attention to wholesalers. Designed primarily for students interested in retailing or wholesaling, and those concerned about mass distribution in marketing consumer goods. *Prep. 43.812.*

### **43.937 Marketing Public Goods and Services**

This course examines public and private institutional systems involved in providing public goods and services (e.g. defense, aerospace and oceanographic services, pollution control) from the standpoint of business markets and participation. Emphasis is on the marketing (buyer-seller) and non-marketing relationships between firms and other institutions involved in policy making, service provision and procurement. *Prep. 43.812.*

### **43.941 Industrial Marketing**

The problems of industrial concerns in marketing their products and services to industrial, business, and organizational customers. Emphasis is placed on determining these customers' needs and on developing programs to satisfy these needs. Topics include the roles and responsibilities of the marketing executive engaged in industrial distribution, advertising, and research, as well as roles and responsibilities of industrial salesmen, sales supervisors, and selling agents. *Prep. 43.812.*

### **44.811 Financial Management I**

This course and its required sequel, 44.812, acquaint students with concepts, practices, and procedures of financial management and offer training in analytical approaches which help them make wise decisions affecting the flow of funds within an organization. Instruction is primarily through readings and cases. *Prep. 41.812.*

### **44.812 Financial Management II**

Concentrates on long-term sources and uses of funds, with an introduction to capital budgeting techniques and the concept of cost of capital. Risk and return trade-offs are included. Broad topics of overall financial strategy and timing are examined. Frequently, evening students are required to prepare a term report based upon data gathered on their jobs and/or from financial literature. *Prep. 44.811.*

**44.814 International Financial Management**

Comprehensive coverage of the field of international financial management, including the fundamental problems of financial forecasting, multinational capital budgeting, affiliate financial structures, international fund movements and instruments of international finance, import-export financing, and the characteristics of foreign environments. Background information is sought in the interpretation of U.S. foreign investment controls and the reaction of foreign governments to U.S. interference. *Prep. 44.812.*

**44.816 The Management of Financial Resources**

Conceptually, decisions regarding the sources and uses of long term funds should be made simultaneously. This course examines both aspects of the decision. A thorough analysis of capital budgeting techniques are combined with an assessment of factors affecting a firm's capital structure. Company assets and how they should be financed are the central questions. *Prep. 44.812.*

**44.818 Working Capital Management**

The current assets and liabilities sections of an organization's balance sheet determine the amount of long term capital committed to working capital uses. This course examines strategies and analytical approaches for making wise decisions affecting these amounts. Material on money market conditions is included. *Prep. 44.812.*

**44.901 Finance III—Advanced Financial Management**

An opportunity to study several important areas of financial management in greater depth than is possible in the basic finance courses. Some of the topics are: corporate capital structure, dividend policy, capital budgeting, and the management of current assets. Instruction is primarily through assigned readings and classroom case discussions. *Prep. 44.812.*

**44.921 Investment Analysis**

Investment principles and risks. The objective is the development of a sound investment program, with attention to identification of investment objectives and risks. Emphasis is placed on the techniques of analysis and evaluation of various types of securities and the associated risks, the operation of the securities markets, and the various methods of portfolio management. *Prep. 15 Q.H. of Grad. Credit.*

**44.924 Mergers and Acquisitions**

This seminar explores the economic environment which has recently given rise to a large number of corporate mergers and the business factors underlying these corporate combinations. The financial, managerial, accounting, and legal factors affecting mergers are studied. Students learn how to appraise a potential merger and structure a merger on advantageous terms. Instruction is through directed readings, case discussions, and independent research. *Prep. 44.812.*

**44.935 Management of Financial Institutions**

The intent is to acquaint students with the broad range of decision-making problems faced by major financial institutions such as commercial banks, savings and investment institutions, and finance companies when viewed as competitive, profit-seeking business entities. Major areas of concern in the course are: sources and uses of funds by financial institutions, competition, regulation, and strategic policy planning by financial institutions. Instruction is primarily through readings and cases. *Prep. 44.812.*

**45.805 - 45.806 Operations Management I & II**

The primary objective is to develop understanding of management in the operations system — its design operation, control, evaluation, and modification. Two second objectives: (1) to increase capability for managerial decision making in technical matters; and (2) to develop an appreciation of the operations manager's job. Topics include: design of product, design of process, human factors engineering, development of capacity, line balancing, man-machines systems, work measurement, job evaluation, wage payments system, project network models, production planning, inventory management, production scheduling and control, and management of product quality and statistical quality control. Operations Management I concentrates on the design of the operations system; whereas Operations Management II focuses on the operation and control. Prep. Basic courses in accounting and control, finance, quantitative analysis, and organizational behavior or permission of the instructor. *Prep. 45.805 for 45.806.*

**45.809 Advanced Operations Management**

This course is designed for those whose career goals are positions of responsibility in the management of the manufacturing or operations function of an enterprise. Although the primary focus is upon manufacturing enterprises, complex operating problems in service-oriented institutions are included. Drawing primarily upon case studies, the course focuses on the development and implementation of detailed responses to the management requirements of operating systems. Emphasis is given to emerging technological developments, such as computer-based mechanization and automation, and to new developments in several areas of production and operations management. *Prep. 45.806.*

**45.813 Operations Management in the Service Sector**

Since the concepts and techniques of Operations Management were first developed in manufacturing settings, traditional courses in operations management have dealt with manufacturing. These concepts and techniques have wide applicability in service and non-profit sectors which need the tools and techniques already used in manufacturing. Concentration is on application of concepts and techniques in the service sector. Industries include: restaurant, health-care, recreation, brokerage, insurance, and airline. *Prep. 45.806 or permission of the instructor.*

**45.815 Behavioral Concepts**

A brief examination of major concepts and findings of the behavioral sciences which have particular pertinence to business and administration. Systematic ways of understanding behavior are developed, taking account of technical, economic, political, and human factors. Individual development is studied from the standpoint of character, perception, learning, and motivation. Behavior of people in small groups is also examined in terms of the structure and dynamics of the individuals in the group. *Prep. none.*

**45.816 Organizational Behavior I**

Basic findings and concepts of the behavioral sciences are related to the specific aspects of behavior in formally constituted organizations. Supervisory behavior is examined in the behavioral context, as well as relations between groups, in order to develop ways of achieving collaboration. *Prep. 45.815.*

**45.817 Organizational Behavior II**

The study of behavior in organizations is expanded to larger organizations in order to

understand and deal systematically with the complex relationships found at this level. This course also provides an opportunity to apply knowledge about people in organizations to the improvement of organizational systems and to the process of achieving changes in organizations. *Prep. 45.816.*

#### **45.819 Interpersonal Behavior**

An intensive inquiry into communications from one person to another, the longest distance of all. Makes use of unconventional media for learning (selected films, drama, and the short story) in which universal qualities of the interactions between people are described, analyzed, and reinterpreted to different settings in today's world. *Prep. none.*

#### **45.821 Policy Formulation in Nonbusiness Institutions**

This seminar focuses primarily on the decision-making process in government institutions, primarily at the Federal level. Readings portray nonrational perspectives on behavior, such as the cybernetic and political models of decisions. Their larger aim is to develop awareness of cognitive limitations of public policy decision-makers and the inherent dysfunctions of bureaucracies in which they operate. Class sessions explore the evolution of public policy, the role of analysis in policy formulation and implementation, and the methodology of policy analysis. The seminar is concerned with strategic decisions rather than with day-to-day operating problems. *Prep. 15 Q.H. of Grad. Credit.*

#### **45.823 Career Planning and Development**

Effective career planning and development is best viewed through the larger context of an individual's actualization process in life. Career evaluation considers personal values, interests, aspirations, sense of self-worth and managerial skills; and on the other hand, the realities of specific occupational and professional choices. Each participant will generate and analyze a wide variety of data to provide better insight into his goals, interests, and managerial skills. Greater career fulfillment is the objective. *Prep. 45.816.*

#### **45.824 Organization Behavior In Non-Profit Environment**

Human services organizations involved in health care, welfare, and education are studied in reference to recent behavioral theories and concepts dealing with the internal and external complexities and inter-relationships of large-scale organizations. Term projects are designed to conduct and analyze a problem situation and develop plans for implementing change. Readings, cases and seminars. *Prep. 45.815, 45.816.*

#### **45.829 New Ventures: A Career Choice**

This course enables students to examine the nature of entrepreneurship and the appropriateness of self-employment for an individual. The focus is on the decision to own and operate one's own business. Students examine the nature of the values, motivations, goals, and life style required by the entrepreneurial role. Guest speakers, cases, selected readings, and self-assessment exercises help students identify the congruency between their own interests and goals and an entrepreneurial career. The course also offers potential value for prospective loan officers, investment bankers and venture capitalists, CPAs, management consultants and others whose career activities may involve them with entrepreneurs and managers of new ventures or smaller companies. *Prep. 15 Q.H. of Grad. Credit, or permission of instructor.*

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### **45.833 Operations Management in the Health Care System**

This course serves those whose career goals are positions of responsibility in the management of the health care system. The objectives of the course are: (1) to provide a basic understanding of operations management problems existing in the health care system, and (2) to develop decision-making ability to deal effectively with these problems. Topics covered in the course are: the fundamentals of management in the health care system, organizational planning, operations planning and control, utilization of resources and policy considerations in effective and efficient operation of the health care system. *Prep. 45.805 and 45.806, or permission of instructor.*

### **45.834 Policy: Environmental Analysis**

This first of three policy courses will focus on the environment in which strategy must be formulated in both profit and non-profit organizations. Techniques of environmental analysis are included with particular emphasis on the political-legal, economic, social, and technological environments as they relate to and influence the formulation of strategy. *Prep. all other required courses with the exception of 41.813, 45.817, 45.836 and 45.837.*

### **45.835 Seminar in Organizational Development**

Organizational development is the process of deliberate organizational change that is planned, organization-wide, and managed from the top so as to increase organizational effectiveness through planned intervention by change agents. This course examines organizational development as an emerging professional discipline, focusing on identifying variables affected by a change program and developing an understanding of methods and techniques. *Prep. 45.817.*

### **45.836 Policy: The Formulation of Strategy**

A continuation of 45.834. Approaches to strategy formulation are developed, compared, and contrasted. Particular emphasis is on the process by which strategy gets formulated in actual business settings, including the influence of personal values on strategy formulation, who actually makes strategic decisions, what environmental and internal information is required to make strategic decisions, and what criteria are used to make the decisions. The role of different management levels in the process is considered. *Prep. 45.834.*

### **45.837 Policy: The Implementation of Strategy**

A continuation of 45.836 with emphasis on the implementation of strategy. Approaches to strategy implementation in both profit and non-profit organizations are compared and contrasted. Topics include: organizational structure and behavior, long-range planning, control and motivation systems, information systems, and leadership. All topics are considered within the systems framework of organizational strategy. *Prep. 45.836.*

### **45.838 Policy Formation in Health Care**

A focus on the problem of defining and implementing policy in the health care sector. The various internal and external components of the health care system are analyzed as they relate to policy-making and implementation. The course also includes a discussion of nontraditional methods of health care delivery such as neighborhood health care centers, health maintenance organizations. *Prep. 15 Q.H. of Grad. Credit.*

**45.840 Managerial Styles and Sex Stereotypes**

Managerial roles are influenced by the leadership styles played by managers of one's own sex as well as those of the opposite sex. The attitudes of management regarding values, interests, aptitudes, and abilities of a person can profoundly influence the personnel decision-making process. Effective managerial leadership encompasses a wide range of decision-making behaviors. These processes are profoundly influenced by socialization, cultural beliefs and identity formation associated with early learning. The dynamics of this self-awareness in understanding sex-role stereotyping, myths, and biases associated with executive responsibility will be examined. Lectures, case discussions, films and guest speakers. *Prep. 15 Q.H. of Grad. Credit.*

**45.841 Public/Private Service Marketing Systems**

Examines public/private institutional systems involved in providing public goods and services (e.g., health care, housing, education, pollution control) from the perspectives of various present or potential participants (business, government, non-profit institutions). Emphasis on analyzing the systems and processes involved, the roles of various participants, and the alternative strategies appropriate for particular participants. *Prep. 15 Q.H. of Grad. Credit.*

**45.843 Environmental Pressures and the Multi-National Corporation**

Rapid multidimensional change in the World Environment creates substantial pressures on corporations, especially large multinationals. The purposes of this course are to identify and evaluate: (1) environmental pressures of most likely significance in the coming decade(s); (2) analysis and planning approaches for the manager's interpretation of the changing world environment; and (3) possible corporate responses to environmental pressures. Consideration will also be given to ideological issues; pragmatic, strategic and tactical adaptation; and structure and managerial changes appropriate to likely developments. *Prep. 15 Q.H. of Grad. Credit.*

**45.902 Planning and Control of Manufacturing Operations**

A study of the problems of managing the flow of materials, operations, and information within an organization in response to, or anticipation of, market demands. The concepts and techniques discussed are applicable in a variety of institutional settings. Topics include: inventory management, demand forecasting, manpower and operations scheduling, project management, and integrated operations control systems. The tone of the course is pragmatic; particular emphasis is on practical evaluation and problems of implementing the analytic methods discussed. *Prep. 45.806 or permission of the instructor.*

**45.951 Executive Development**

An examination of the executive position in an organization and the personal characteristics and skills which it requires. The course examines the effects of cultural change and shifting mores on motivation and management control, with their implication for developing appropriate organizational relationships. Report writing, oral reports, and leading of group discussions are dominant techniques. Student evaluation is encouraged. *Prep. 15 Q.H. of Grad. Credit.*

**45.965 Management of Small Business Enterprises**

Problems in various beginning stages of management of new small enterprises. Case studies develop analytical approaches for appraising the risks and rewards of poten-

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tial growth opportunities, as well as operating problems. Problems range from locating, evaluating and financing a small company, to the survival and growth of an established business. Guest speakers relate pertinent business experiences to in-class activities. *Prep. 15 Q.H. of Grad. Credit.*

### **45.968 Management of New Enterprises**

Oriented toward the entrepreneur. Consideration given to locating and evaluating business opportunities introduced by new ideas, product development, licensing, inventions, patents, etc. The organization, start, and growth of a new business or the acquisition of a going concern, including fund raising and related state regulations. *Prep. 15 Q.H. of Grad. Credit.*

### **45.969 Government and Business**

Analysis of the role of government as a regulating force, as well as the nature and impact of government fiscal, economic, and socio-economic policies on the conduct of business. The political and economic philosophies behind greater government participation in the economic structure of the nation as indicated by public-utility, anti-trust, labor, and socioeconomic legislation. *Prep. 15 Q.H. of Grad. Credit.*

### **45.971 Personnel Management**

The purpose of this course is to provide knowledge of basic personnel functions: recruitment, selection, placement, rewards, compensation, training and development of employees. Implications of new government regulatory systems also considered such as equal opportunity, safety and pensions; to demonstrate implementation of behavioral theories at the workplace. Emphasis on partnership of specialists and generalists in overall management of organizations' human resources. Lectures, cases and readings. *Prep. 15 Q.H. of Grad. Credit.*

### **45.972 Labor Relations**

Review of U.S. labor history and traditional labor policy as well as implications of new regulatory systems on labor management relations such as equal opportunity and safety. Overview of collective bargaining processes applied to emerging sectors of union organization such as health care and education. Lectures, cases and readings. *Prep. 15 Q.H. of Grad. Credit.*

### **45.973 New Sectors of Collective Bargaining**

A focus on new sectors of bargaining: 1. by public employees, including municipal, state, and Federal; 2. by professional associations, including those of teachers, doctors, nurses, and engineers; and in the mainly unorganized sectors; i.e., agriculture, health care industry, and so-called white-collar-service areas. The purpose is to study the variety of patterns emerging in these sectors as a result of the interplay of the following forces: 1. presence or absence of a national labor law or policy; 2. relationship to existing trade union structure and industrial relations system; 3. occupational characteristics and industry or service technology, and 4. productivity and growth. Varying issues in collective bargaining are discussed through cases, readings, and a group term project, and by invited practitioners. *Prep. 15 Q.H. of Grad. Credit.*

### **45.975 Introduction to Health Care Systems**

The present state of the system, dealing with its history and process and describing the parts of the delivery system, the payers, the consumers, the manpower, and the



policy implications. Comparative health care systems will be discussed. Lectures, discussions and readings. Recommended for those entering the field. *Prep. 15 Q.H. of Grad. Credit.*

#### **45.976 Workers in the Health Care System**

The present health care system in the United States is in the process of major change generated by both the internal and external social, legal, and professional environments. The purpose of this course is to describe and analyze some of the dynamics and complexities of these changes and to consider how these changes affect the workers in the system. In turn, the worker's influence on these changes is studied. The foci are the past, present, and future of major occupation levels and groupings servicing the system, their relationship to each other and to the total system. A major feature of the course is a group research project. Case studies, readings, lectures, and guest speakers are also used. *Prep. 45.815, 45.816.*

#### **45.977 Information Systems for Health Care Facilities**

Introduction to the complexities of the quantity and variety of information availability in the field and the state of the technology capability, as well as an understanding of the system's components through use of this information. Course covers systems information flow and new computer techniques. Cases, readings, and on-site visits. *Prep. 15 Q.H. of Grad. Credit.*

#### **45.991 Business Law—Law of Contracts, Agency, and Sales**

Designed to give the student a basic knowledge of the legal aspects of contracts and the results of contractual obligations. Attention is paid to the employment contract in general, with emphasis on the principal and agent, and the master and servant relationships. The law governing the sale of personal property as reflected in the Uniform Commercial Code is incorporated. *Prep. 15 Q.H. of Grad. Credit.*

#### **45.992 The Law of Business Organizations and Negotiable Instruments**

The Law of Negotiable Instruments as reflected in the Uniform Commercial Code, with special consideration given to commercial paper used in business transactions. The law governing formation and operation of partnerships, corporations, and other business organizations, with emphasis on the legal results and operations of those concerned with the liability of members thereof. A study of the legal framework within which the formal business organization must operate. *Prep. 45.991 and 15 Q.H. of Grad. Credit.*

#### **45.993 Labor Law**

An overview of constitutional and legal problems involved in labor organizing, industrial relations, labor negotiations, labor contract enforcement, and dispute resolution in both private and public sectors of labor administration. Cases are studied for the legal principles underlying common law, state and federal laws, and constitutional questions of power and authority. *Prep. 15 Q.H. Grad. Credit.*

#### **45.997 Special Studies in Business Administration (1 Q.H. Credit)**

A special tutorial arrangement between a student and a faculty member for a guided reading, research, laboratory, fieldwork, report, or teaching experience. It is for graduate students who desire to do advanced work or carry out some special investigation of a problem in business administration not specifically covered elsewhere in the curriculum. Students must petition the Committee on Graduate Study in

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Business Administration for permission to register in this course. This petition should include an outline, a brief description of the work planned, and an indication of the professor to whom the student will be responsible. The professor will submit to the Graduate Office a letter outlining in some detail the nature of the work that the student will be doing in the course. The petition will be submitted after the student has received permission to take the course from a member of the College of Business Administration faculty. The course carries variable credit, ranging from one to three quarter hours. *Prep. 15 Q.H. of Grad. Credit.*

### **45.998 Special Studies in Business Administration** (2 Q.H. Credit)

See 45.997 for course description.

### **45.999 Special Studies in Business Administration** (3 Q.H. Credit)

See 45.997 for course description.

### **46.810 Managing the Multinational Enterprise**

This course is designed to provide an introductory exposure to the international business field, as well as to serve as the theoretical basis for further exploration of the more practical aspects of international business operations. The opening section deals with international economic, financial, and commercial relationships. This is followed by a section on the multinational enterprise. The third section deals with the interface between the firm and the international business environment. The final section focuses on current issues in U.S. public policy affecting international business. *Prep. 49.901.*

### **48.801 Seminar in Intercity Transportation**

The objectives are twofold: 1. to provide a basic understanding of the functions and importance of the domestic transportation system, and 2. to develop the student's ability to analyze government policies related to transportation. The cost, service, and pricing characteristics of the several modes of transportation are examined. Emphasis is given to the special problems which confront both carriers engaged in the various forms of transportation and shippers who rely upon their services. *Prep. 15 Q.H. of Grad. Credit.*

### **48.805 Urban Transportation**

This course examines urban transportation from the Federal, state, and local levels. Emphasis is given to the role of transportation in community development, Federal programs concerning transit, and current urban transportation problems in the Boston metropolitan area. *Prep. 15 Q.H. of Grad. Credit*

### **48.901 Transportation and Corporate Distribution**

Study of the design and management of physical distribution systems to facilitate the flow of goods through distribution channels. It covers aspects of plant and warehouse locations, inventory controls, and selection of transportation carrier. The course includes the use of case problems in logistics. *Prep. 15 Q.H. of Grad. Credit.*

### **49.901 Managerial Economic Analysis**

Managerial economic analysis establishes the economic foundations and framework for managerial decisions. The course provides an introduction to the principles of economic analysis, economic institutions, and issues of public policy. It stresses the interdependency of the economic decisions of the firm with industry structures and national economic policies. Topics covered include: sources, market decisions and

market structure, employment and growth, and the economic role of governmental resource allocations. *Prep. none.*

#### **49.902 Quantitative Analysis I**

Decision making takes place in a probabilistic environment. The concept of statistical inference is emphasized, with the objective of generating and understanding the process by which the analyst draws conclusions from a small sample compared to the characteristics of a large data set. The techniques employed in decision making under uncertainty (payoff tables, decision trees) are also discussed. *Prep. None.*

#### **49.903 Quantitative Analysis II**

Introduction to the theory and practice of management science and operations research. The topics of regression analysis, linear programming, and simulation are discussed in text and case material; emphasis is on practical application of these techniques. Issues of problem definition, model building, relevant cost determination, solution generation, and implementation of results are considered. *Prep. 49.902.*

#### **49.908 Mathematics for Managerial Decisions**

The two-fold objective of this course is: (1) to provide an introduction to the most important mathematical concepts and tools used today by modern management; and (2) to illustrate the applicability of mathematics to problems in economics, finance, production, marketing, statistics, computers and other related fields. This course is designed for students who do not consider themselves mathematically sophisticated or for those needing a review before taking other quantitative courses. Topics to be covered are: Set Theory, Functions and Systems of Equations, Matrices, Differential Calculus, and Introduction to Mathematical Optimization Models. *Prep. None.*

#### **49.909 Managerial Economics II**

The objectives of this course are to develop proficiency in the application and the use of economic concepts for decision-making in business and to relate the economic environment to the business decisions. Topics like estimation of demand and cost industry structure and its impact on the conduct of business firms, antitrust legislation and economic forecasting are discussed. *Prep. 49.901 (or equivalent), 49.902 or permission of instructor.*

#### **49.918 Information Theory and Systems**

The objective of this course is to develop a framework for the analysis of communication and information systems in organizations. Aspects of communications theory are studied as background for building this framework and its underlying theory is tested. Topics include development of an analytical framework for viewing information systems and communication in organizations. Various aspects of communications theory are discussed and analyzed. A major objective of the communications and information flow in organizations is to tie these events back to the underlying theory. *Prep. 15 Q.H. of Grad. Credit.*

#### **49.932 Introduction to Computer Applications**

A business-oriented introduction to data processing functions and systems. Introduction to the history, terminology, technology, and economics of data processing hardware and software. Management issues in the design, selection, evaluation and use of computers and computer services. Individual familiarization with elementary computer programming by using either batch or time-shared computer facilities to

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solve simple business-oriented exercises. When feasible, a visit to a data processing center is conducted. *Prep. None.*

### **49.933 Management Information Systems**

The Management Information System (MIS) concept which stresses how a computer-powered information system can benefit all levels of management is emphasized. The course illustrates the economics of MIS and computers, describing the steps necessary for successful installation and employment of MIS concepts. An extensive case study illustrates systems design, dollar/benefit tradeoffs, and the proper level of management involvement. Familiarization with the systematic or systems approach to analyzing and solving computer and information systems problems as well as general business problems. Business management rather than computer technology is stressed. *Prep. 49.932.*

### **49.935 Computer Applications in Management Science**

Discussion of the technical, economic, and procedural aspects of applying quantitative techniques of management science to planning and operations problems. Heavy emphasis is on the computer's role in this process. Concentration is on selected techniques such as linear programming, simulation, and multiple regression analysis. Practical problems of designing computer programs, selecting canned packages, gathering data, and implementing results are considered. The required term project allows an in-depth study of an area and/or technique of the student's choosing. This project may take a variety of forms: a computer model written by the student, use of a canned package or a model written by others, library research report, formulation of a practical problem for future solution. Ability to program is not required, nor is computer programming emphasized; however, extensive time-sharing and batch-processing computer service is available for those who wish to use it. *Prep. 49.902, 49.903, and 49.932.*

# undergraduate universities attended by students

Air Force Academy  
Amherst College  
Arizona, University of  
Assumption College  
Bates College  
Bentley College  
Boston College  
Boston University  
Bowdoin College  
Brandeis University  
Bridgeport, University of  
Brooklyn Polytechnic Institute  
Brown University  
Bucknell University  
Calcutta, University of (India)  
California, University of  
Canisius College  
Case Institute of Technology  
Catholic University of America  
Catholic University (Venezuela)  
Cincinnati, University of  
City College of New York  
Colby College  
Colgate University  
Columbia University  
Connecticut, University of  
Cornell University  
Dartmouth College  
Delaware, University of  
Denison University  
Drake University  
Drexel University  
Duke University  
Fairfield University  
Florida, University of  
Fordham University  
Franklin and Marshall College  
Gettysburg College  
Hartford University  
Harvard University  
Hawaii, University of  
Hiram College  
Hobart College  
Hofstra University  
Holy Cross College  
Houston, University of  
Illinois, University of  
Institute of Science (India)  
Ithaca College  
Johns Hopkins University  
Lafayette College  
Lake Forest College

Lehigh University  
Lowell Technical Institute  
Loyola University (Chicago)  
Maine, University of  
Maryland, University of  
Massachusetts Institute of Technology  
Massachusetts Maritime Academy  
Massachusetts, University of  
McGill University (Canada)  
McMaster University (Canada)  
Merrimack College  
Nebraska, University of  
New Hampshire, University of  
Northeastern University  
Notre Dame, University of  
Ohio Wesleyan University  
Pennsylvania State University  
Pennsylvania, University of  
Plymouth State College  
Providence College  
Radcliffe College  
Rensselaer Polytechnic Institute  
Rhode Island, University of  
Rochester Institute of Technology  
Rochester, University of  
Rutgers, The State University (New Jersey)  
St. Anselm's College  
St. John University  
St. Lawrence University  
Simmons College  
Smith College  
Stanford University  
State College at Boston  
State University of New York, at Buffalo  
State University of New York, at Genesee  
State University of New York, at Oneonta  
Stonehill College  
Suffolk University  
Sydenham College (India)  
Syracuse University  
Tennessee, University of  
Texas, University of  
Tufts University  
United States Merchant Marine Academy  
United States Military Academy  
United States Naval Academy  
Vermont, University of  
Villanova University  
Virginia Polytechnic Institute  
Wesleyan University  
Worcester Polytechnic Institute  
Yale University

# faculty directory

<i>Name</i>	<i>Room</i>	<i>Extension</i>
Agostino, Donald J.	213 HA	437-3252
Arnett, Matthew D.	305 HA	3257
Chugh, Lal C.	205 HA	3264
Clarkson, Geoffrey P.E.	202 HA	3230
Collazzo, Charles J.	322 HA	3260
Crotty, Philip T.	202 HA	3230
Curran, Joseph R.	404 HA	3246
Dunn, Jr., Dan T.	322 HA	3260
Fetters, Michael L.	402 HA	3304
Fiumara, Angelo J.	204 HA	3236
Frantzis, Stavros S.	213 HA	3252
Godin, Victor	213 HA	3252
Golemme, Joseph M.	206 HA	3244
Graetz, Herbert G.	305 HA	3257
Grusetskie, Maryann I.	224 HA	2714
Gubellini, Carlo E.	404 HA	3241
Hehre, Robert J.	205 HA	3264
Higgins, Richard B.	304 HA	3257
Hobart, Christine L.	305 HA	3257
Janell, Paul A.	402 HA	3369
Jordan, John W.	202 HA	3230
Keith, Lyman A.	204 HA	3236
King, John F.	213 HA	3252
Kinnunen, Raymond M.	204 HA	3236
Kriebel, Henry A.	404 HA	3243
Lawler, Susan V.	224 HA	2714
Leary, John J.	212 HA	3274
Lenarcic, Michael A.	205 HA	3265
Lieb, Robert C.	204 HA	3236
Lindhe, Richard	402 HA	3285
Mahapatra, Sitikantha	404 HA	3269
Malchman, Lawrence H.	404 HA	3284
Marple, Jr., Wesley W.	209 HA	3248
McCarthy, Daniel	302 HA	3255
McDonald, Philip R.	322 HA	3260
Minichiello, Robert J.	302 HA	3255
Moore, Thomas E.	224 HA	2714
Nelson, Carl W.	213 HA	3252
Olive, Russell W.	302 HA	3255
Parsons, Robert A.	303 HA	3255
Pattillo, Donald M.	205 HA	3265
Priem, Andre P.	302 HA	3255
Ramsier, Dennis	225 HA	3270
Reitz, Barbara W.	225 HA	3270
Rugina, Anghel N.	209 HA	3248
Santos, Richard J.	212 HA	3272
Scioletti, Daniel C.	204 HA	3236
Shelley, Charles	204 HA	3236
Spencer, Myron J.	212 HA	3274
Spital, Francis C.	305 HA	3257
Stephenson, Frederick J.	204 HA	3236
Sternal, Branch K.	205 HA	3265
Suojanen, Wayne W.	305 HA	3257
Timmons, Jeffrey A.	304 HA	3255
Wheeler, Bric	212 HA	3273
Willett, Edward R.	209 HA	3248
Williams, Dennis S.	225 HA	3270
Winston, Rudolph	305 HA	3257
Wiseman, Frederick	322 HA	3260



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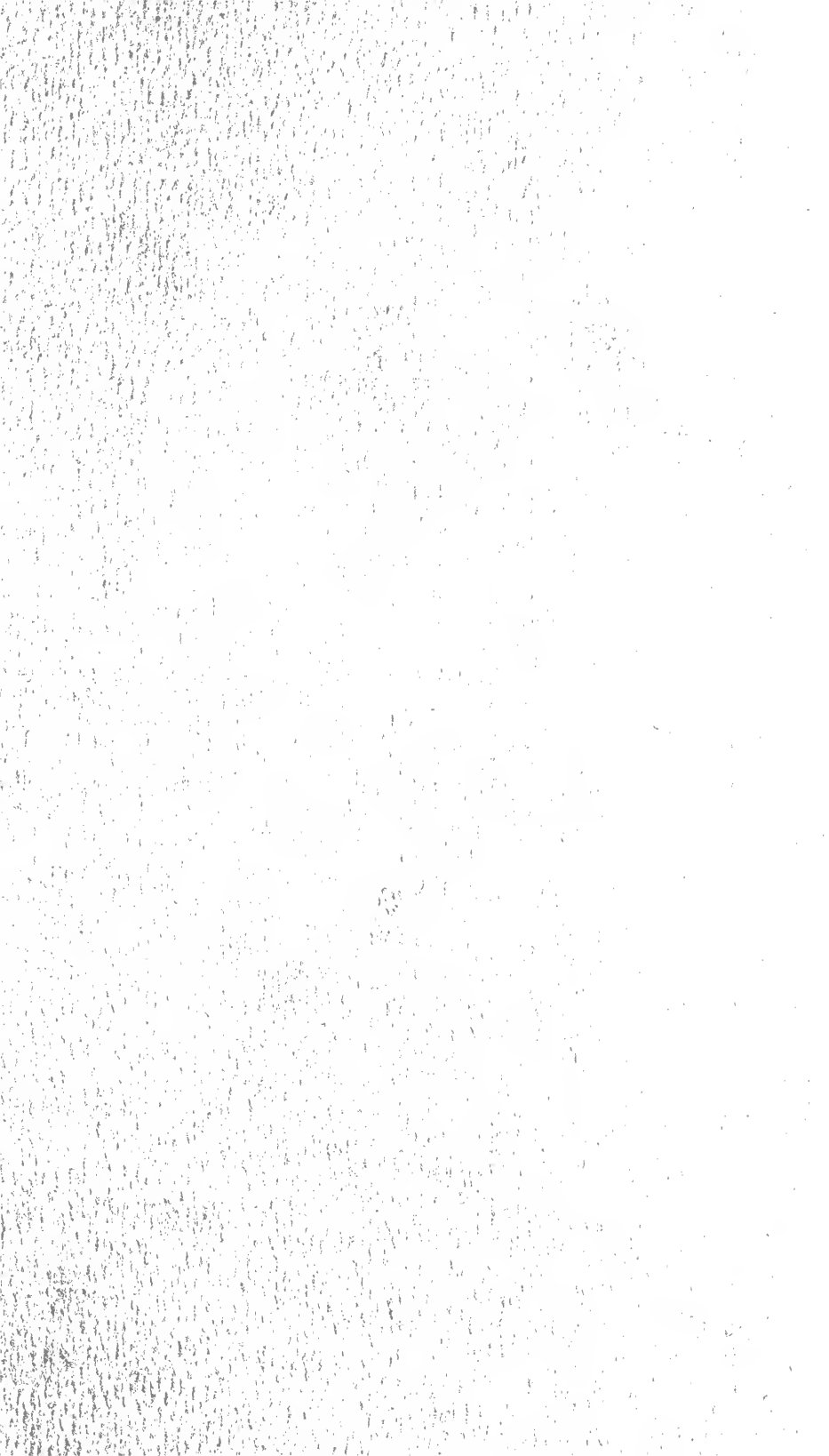
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**300**







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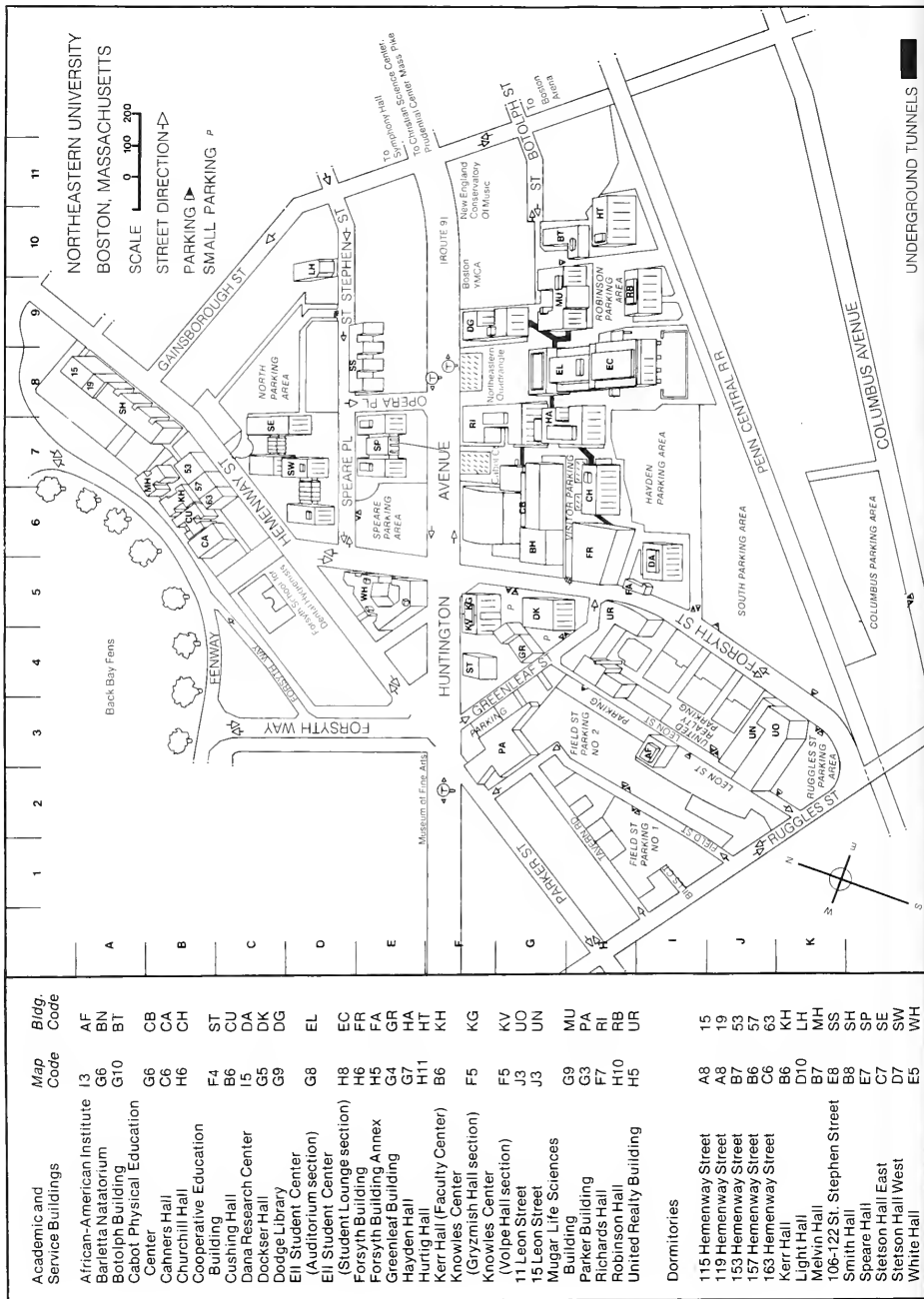
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NORTHEASTERN

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UNDERGROUND TUNNELS

## ACADEMIC CALENDAR 1976—1977

### Fall Quarter 1976

Registration period		
Burlington	Tuesday—Wednesday	Sept. 14—15
Boston	Monday—Thursday	Sept. 20—23
Classes begin	Monday	Sept. 27
Examination period	Monday—Saturday	Dec. 13—18

### Winter Quarter 1976—1977

Registration period		
Burlington	Tuesday	Nov. 30
Boston	Monday—Thursday	Dec. 6—9
Classes begin	Monday	Jan. 3
Examination period	Monday—Saturday	Mar. 21—26

### Spring Quarter 1977

Registration period		
Burlington	Tuesday	Mar. 8
Boston	Monday—Thursday	Mar. 14—17
Classes begin	Monday	Apr. 4
Last day to file card for		
Spring Commencement	Friday	Apr. 1
Last day to pay fee for		
Spring Commencement	Friday	Apr. 29
Final grades due in Registrar's		
Office for June graduates	Friday	June 3
Examination period	Monday—Saturday	June 13—18
Spring Commencement	Sunday	June 19

### Summer Quarter 1977

Registration period		
Burlington	Monday—Tuesday	June 13—14
Boston	Wednesday—Thursday	June 15—16
Classes begin	Monday	June 27
Last day to file card for		
Fall Commencement	Friday	July 1
Last day to pay fee for		
Fall Commencement	Monday	Aug. 1
Examination period	Wednesday—Thursday	Aug. 3—4

## UNIVERSITY HOLIDAYS 1976—1977

Columbus Day	Monday	October 11
Veterans' Day	Thursday	November 11
Thanksgiving Recess	Thursday—Saturday	November 25—27
Christmas Vacation	Monday—Saturday	Dec. 20—Jan. 1
Martin Luther King Day	Saturday	January 15
Washington's Birthday	Monday	February 21
Patriot's Day	Monday	April 18
Memorial Day	Monday	May 30
Independence Day	Monday	July 4
Labor Day	Monday	September 5

## Equal Opportunity Policy

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees.

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1976—1977

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# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature by special enactment has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of nearly 180 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922), Liberal Arts (1935), Education (1953), Pharmacy (1962), Nursing (1964); Boston-Bouvé College (1964); the College of Criminal Justice (1967); and by Lincoln College's daytime Bachelor of Engineering Technology program (1971). This educational method enables students to gain valuable practical experience as an integral part of their college program and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses — offered by the University since 1906 — and adult-day courses leading to the bachelor's degree. In addition to offering day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The 10 graduate and professional schools of the University offer day and evening programs leading to the degrees listed.

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.



The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science, with specialization in Physical Education and Recreation Education.

The Graduate School of Business Administration offers the degree of Master of Business Administration.

The Graduate Program in Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degree of Master of Education, the Certificate of Advanced Graduate Study, and the Doctor of Education.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer degree, Doctor of Engineering, and Doctor of Philosophy.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

### **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established in 1960 to relate the University to the needs of its community in a period of accelerated change. Adult education programs offered by the Center and University College have since been consolidated. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

### **RESEARCH ACTIVITIES**

The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning take place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

# buildings and facilities

## MAIN CAMPUS

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intra-state lines, and MBTA subway-bus service within the metropolitan suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 48 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## Ell Student Center

The Carl S. Ell Student Center provides facilities for student recreation and for extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the Center. Also included are special drama facilities, a ballroom, main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

## Libraries

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Burlington; the School of Law Library; and divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, Mathematics and Psychology, and Health, Physical and Recreation Education, and Physical Therapy. There are additional subject collections for the Center for Management Development at Andover, Massachusetts, and the Marine Science Institute in Nahant.

The library collections number 400,000 volumes supplemented by some 333,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,700 periodical titles, 100,000 documents, and 4,600 sound recordings.

### **Cabot Physical Education Center**

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. The large gymnasium contains four basketball courts. In addition, the Center consists of an athletic cage, a small gymnasium, and a rifle range, as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouvé College.

A recent addition to the Center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball courts, and shower and dressing facilities.

### **Dockser Hall**

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

### **Apartments for Graduate Students**

The University maintains a 100-apartment housing unit which accommodates 279 people. Two-, three-, and four-party apartments are available which vary in size from two to four rooms plus bath. Apartments are furnished with beds, chairs, desks, stove, refrigerator, and kitchen table. The cost includes all utilities.

A \$100 deposit is required when making application for the apartments. Applications are available in the Office of University Housing. Students are expected to make such arrangements on a term-to-term basis but may live in the apartments both while on cooperative work assignments and in school if they wish. All reservations are made on a first come, first served basis.

## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, business administration, science, education, and the arts, portions of undergraduate programs leading to the associate and bachelor degrees, special programs for adults, and noncredit state-of-the-art programs are offered.

### **Warren Center**

The Warren Center is a practical laboratory for Boston-Bouvé College in outdoor education and conservation, in group practicum, and in camping

administration, programming, and counseling. At this Center in Ashland, completed in 1967, there are tennis courts, field hockey and lacrosse fields, waterfront for swimming and boating, overnight camp sites, fields and forests, heated cottages, the Hayden Lodge with a recreation hall, library, crafts shop, dining facilities, and conference accommodations.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.

### **Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility primarily engaged in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at this Institute are applicable toward an advanced degree in biology or health science.

### **Government Center Campus**

With the cooperation of the Federal Executive Board, the Graduate School of Liberal Arts' Department of Political Science offers an entire Master of Public Administration program at the John F. Kennedy Building in downtown Boston. This program is primarily for individuals employed in Federal, state, or local civil services.

### **Brockton, Nashua, and Framlingham Campuses**

For students residing in southeastern Massachusetts and northeastern Rhode Island, the Graduate School of Business Administration offers a significant portion of its M.B.A. Program at facilities in Brockton, Massachusetts. These facilities, made available by the Knapp Corporation, are located on West Chestnut Street in Brockton.

Students residing in the southern New Hampshire area may take a significant portion of the M.B.A. Program at facilities in Nashua, New Hampshire. These facilities are furnished by Sanders Associates, Inc. and are located in their headquarters on Route 3, just over the Massachusetts line.

For students in the Framingham-Worcester area, a significant portion of the M.B.A. Program may be taken at classroom facilities located in Framingham, Massachusetts.

# the graduate school of pharmacy and allied health professions

The New England College of Pharmacy merged with Northeastern University in 1962 to become the College of Pharmacy of Northeastern University. The Graduate School of Pharmaceutical Sciences was established in 1964 and offered on a full-time basis Master of Science degree programs in Hospital Pharmacy, Industrial Pharmacy, Medicinal Chemistry, and Pharmacology. All of these programs involved one year of planned cooperative work experience. In 1970 a doctoral program leading to the Ph.D. in Medicinal Chemistry was instituted.

The necessity for making these Master of Science degree programs more relevant to the greater Boston community led to the establishment of part-time evening programs. In 1971 the Division of Allied Health Sciences joined with the College of Pharmacy to establish the new College of Pharmacy and Allied Health Professions. In 1972 two new part-time Master of Science degree programs were inaugurated, one in Medicinal Laboratory Science and the second in Clinical Chemistry, the latter being cosponsored by the Chemistry Department in the Graduate School of Arts and Sciences. In 1974 a Master of Science degree program in Radiopharmaceutical Science was established.

Currently the College offers the following graduate programs:

## **Master of Science**

- Clinical Chemistry
- Hospital Pharmacy
- Medical Laboratory Science
- Medicinal Chemistry
- Pharmacology
- Radiopharmaceutical Science

## **Doctor of Philosophy**

- Medicinal Chemistry

## **Interdisciplinary Doctor of Philosophy**

- Clinical Chemistry
- Forensic Chemistry
- Pharmacology
- Radiopharmaceutical Science

## **GENERAL REGULATIONS**

The general regulations that follow are minimal requirements shared by the several degree programs. The student is advised to consult the appropriate program for a statement of specific requirements.

### **Application**

Applicants should address their inquiries to the Director of the Graduate School of Pharmacy and Allied Health Professions. Application forms and other pertinent information will then be mailed to them. Submission of the completed forms, together with all official transcripts and two letters of recommendation, is essential before potential students can be considered for admission to a specific degree program. Applicants whose native language is not English must take the Test of English as a Foreign Language and submit the results to the Director of the Graduate School of Pharmacy and Allied Health Professions. All necessary supporting documents must be on file at least four weeks before the date of registration for the quarter in which the student expects to begin his scholastic program. Consideration of applications received after this date may be delayed.

Applicants to the doctoral program who desire assistantships should apply no later than March 15. It may not be possible to give equal consideration to applications received after this date. Candidates for financial awards should so indicate in their letter of application. These awards are restricted to full-time doctoral students. Such applicants are strongly urged to take both the aptitude and advanced portions of the Graduate Record Examination.

### **Admission**

To be enrolled for graduate work, an applicant must submit a complete official transcript indicating the award of a baccalaureate degree from a recognized institution. He must also provide evidence of his ability to pursue creditably a program of graduate study in his chosen field. His scholastic record must therefore show academic distinction, and his undergraduate program must show breadth as well as adequate preparation in his field of anticipated specialization. Acceptance to the school is granted upon recommendation of the Graduate Committee of Pharmacy and Allied Health Professions after a review of the completed application.

Foreign students who do not receive a graduate award or whose award is insufficient to cover all educational and living expenses must certify that they are able to meet all such expenses while at Northeastern. A visa may not be granted without such certification. Foreign students should note that many of the master's degree programs are part time and, therefore, students are not eligible for I-20 visas.

## **Student Classifications**

*Regular Students* — Those students accepted to a specific degree program.

*Special Students* — Students who have been accepted in the graduate school, but who are not formally matriculated in a degree program. Students in this category who wish to be admitted to a degree program must petition the Graduate Committee requesting a change in status. This request is to be made after the completion of 12 quarter hours of graduate credit. No more than 16 quarter hours may be transferred from the Special Student category to a degree program. In those instances where additional courses have been taken, only the first 16 quarter hours of credit will be accepted. Special Students are expected to obtain a B average. All courses within this 16 quarter hour limitation will be transferred if the student is admitted to a degree program; included will be C, F, and I grades. It is the student's responsibility to request a change of status in writing.

*Doctoral Students* — Students admitted to a doctoral program.

*Doctoral Degree Candidates* — Doctoral students who have completed 40 quarter hours of acceptable graduate work and who have passed the qualifying examination.

## **Registration**

Students must register within the dates and times listed on the school calendar. The place of registration is announced prior to each period.

## **Residence**

All course work for advanced degrees must be registered for and completed at Northeastern University unless the Graduate Committee has granted approval of work taken elsewhere.

## **Programs of Study**

The study load for full-time students is 8 quarter hours of course work or a combination of fewer credits together with an independent research project. Students involved in such a project will work closely with their advisors to determine their individual course load assignments. Part-time students decide upon their course load after consulting with the director of their specific program. Courses in most fields are generally offered in the late afternoon and evening. Exceptions to this are posted with the quarterly list of course offerings.

## **Grading System**

Performance of students in graduate courses is graded as follows:

### **A Excellent**

This grade is given to those students whose performance in the course has been of very high graduate caliber.

**B Satisfactory**

This grade is given to those students whose performance in the course has been at a satisfactory level.

**C Fair**

This grade is given to those students whose performance in the course is not at the level expected in graduate work.

**F Failure**

This grade is given to those students whose performance in the course is unsatisfactory.

In addition, the following letter designations are used:

**I Incomplete without quality designation.**

This grade may be given to those students who fail to complete the work of the course.

**L Audit without credit.**

**S Satisfactory without quality designation.**

**U Unsatisfactory without quality designation.**

An S or U grade is used for the first quarter of a two-quarter sequence in which the grade for the second quarter applies to both the first- and second-quarter sequence.

The I grade will be changed to a letter grade when the deficiency which led to it is made up to the satisfaction of, and in the manner prescribed by, the course instructor, or, in his absence, by the chairman of the department issuing the grade. The period for clearing such a grade is restricted to one calendar year from the date of its first recording on the student's permanent record.

Students must indicate their preference for auditing a course at registration. No credit is given for the course; however, it will appear on the student's transcript. Registration changes from an audit to a graded status, or vice versa, must be made prior to the second week of classes. The tuition fee for an audit course is the same as that for a graded course.

### **Class Hours and Credits**

All courses are entered as quarter-hour credits. A quarter hour of credit is equivalent to three fourths of a semester-hour credit.

### **Continuity of Program**

Students are expected to maintain continuous progress toward a degree. Any student who does not attend Northeastern for a period of one year must apply for readmission.

### **Withdrawals**

In order to withdraw from a course, a student must complete an official withdrawal form obtained at the Registrar's Office or at the Suburban Campus Office. Withdrawals may be made through the first six weeks of the course or upon the receipt of a mid-term examination, whichever is later.



Students are withdrawn on the date at which the official form is filed with the Registrar. Ceasing to attend class or notifying the instructor does not constitute official withdrawal.

### **Changes In Requirements**

The continuing development of the Graduate School forces frequent revision of curricula. In every new bulletin some improvements are indicated. When no hardship is imposed on the student because of changes, and when the facilities of the school permit, the student is expected to meet the requirements of the current bulletin. Any deviation from this must be requested by petition to the Graduate Committee.

### **Application for the Diploma**

A commencement card must be filed with the Registrar's Office on or before the applicable date listed in the calendar. For students failing to file, there is no assurance that the degree will be granted in that particular year, even though all other requirements have been fulfilled.

## **THE MASTER OF SCIENCE DEGREE**

### **Admission**

Specific requirements for each degree program are found in the appropriate paragraphs for each program, beginning on page 36.

### **Academic Requirements**

A candidate for the master of science degree must complete a minimum of 40-43 quarter hours of correlated work of graduate caliber and such other study as may be required by the specific program.

During the first half of the total course work hours required for the degree, the candidate is expected to maintain a minimum quality-point average of 2.5. At completion of three fourths of the total course work hours required for the degree, the candidate is expected to have a quality-point average of 2.8. To qualify for the degree, he must obtain a final average of 3.0, equivalent to a grade of B. This average is calculated quarterly by the graduate school on the basis of A = 4, B = 3, C = 2, and F = 0, and excludes any transfer credits from outside the University.

Not more than four quarter hours (generally two courses) of repeated courses, additional courses, or permanent Is may be allowed in order to satisfy the degree requirements.

Within the above limitations, a required course for which a grade of F is received must be repeated with a grade of C or better, and may be repeated only once. If a grade of F is received in an elective course, that course may be repeated only once to obtain a grade of C or better, or another elective course may be substituted for it. If a grade of C is received in a required course, that course may be repeated once to obtain a grade of B or better.

### **Obtaining a Second Master's Degree**

Students who have completed an M.S. degree in the Graduate School of Pharmacy and Allied Health Professions and wish to obtain a second master's degree, should petition to do so. Students will be required to complete all the requirements listed for the second program, taking a minimum of 16 additional quarter hours of graduate credit.

### **Transfer Credit**

A maximum of 12 quarter hours of credit obtained at another institution may be accepted toward the master's degree, provided that the credits transferred consist of A or B grades in graduate-level courses, are in the candidate's field, have been earned at a recognized institution, and have not been applied toward any other degree. Students should petition the Graduate Committee in writing for all transfer credit. Transfer credit grades may not be used in order to obtain the academic average necessary for completion of degree requirements.

Students changing majors within the College or University will receive transfer credit on a graded basis for ALL required courses taken in the desired new major. In addition a maximum of 12 quarter hours of credit for courses in the elective categories completed with the grades of A or B may be transferred. Transfer credit for elective courses may not be used in order to obtain the academic average necessary for completion of degree requirements.

### **Time Limitation**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years unless an extension is granted by the Committee of the Graduate School of Pharmacy and Allied Health Professions.

## **THE DOCTOR OF PHILOSOPHY DEGREE**

The doctor of philosophy degree is awarded to candidates who give evidence of high attainment and research ability in their major field. The degree requirements are administered by the Graduate Committee. It is the responsibility of the Director of the Doctoral Program to certify to the Graduate Committee the completion of all requirements for each candidate.

### **Admission**

The degree program in the Department of Medicinal Chemistry and Pharmacology has an established admission procedure for students starting doctoral work at Northeastern University. The Ph.D. in Medicinal Chemistry provides specialization in the fields of Clinical Chemistry, Forensic Science, Pharmacology, Radiopharmaceutical Science, and Synthetic Medicinal Chemistry.

## **Residence Requirements**

Candidates for the doctor of philosophy degree must spend the equivalent of at least one academic year in residence at the University as full-time graduate students. The Graduate Committee specifies the method of satisfying the residence requirement.

## **Doctoral Entrance Examination**

Upon acceptance into the doctoral program, the student must take an entrance examination. The purpose of this examination is twofold: to test his undergraduate knowledge and skills considered essential to success in the field of specialization, and to aid both the student and a selected faculty adviser in course selection to overcome existing deficiencies in academic background. Within one year of admission to the doctoral program, the student is allowed two opportunities to pass the examination.

At its discretion, the Department of Medicinal Chemistry and Pharmacology may drop a student from the doctoral program if the results of the doctoral entrance examination reveal deficiencies too great to be removed within one year.

## **Qualifying Examination**

A qualifying examination is prepared by members of the department and given twice each academic year. It is expected that a student will take this examination within two years from the date of the doctoral entrance examination. The purpose of the qualifying examination is to test the student's knowledge and skills in medicinal chemistry and especially his knowledge of recent developments in this field.

This examination is composed of two parts:

1. A written examination in areas of specialization in the department to be determined by the department.
2. An oral examination, given approximately two weeks after completion of part 1. The oral examination committee consists of the dissertation adviser (selection discussed below), two other members of the Department of Medicinal Chemistry and Pharmacology, and one member of the University from outside the Department selected by the Department Chairman. The student must pass the written portion before taking the oral examination at the scheduled time. Students failing the written part of the qualifying examination are given one opportunity to remove this failure by a make-up examination. Similarly, students have one additional opportunity to pass the oral examination. Students must make up any failure at the first opportunity. Those failing either portion of this examination twice are dropped from the program. A student who passes the qualifying examination and completes 40 quarter hours of graduate work with a 3.0 average is designated a Doctoral Degree Candidate.

### **Course Requirements**

The minimum course requirement of 40 quarter hours of credit constitutes the work normally required for the master's degree. The course requirements beyond this total for the Ph.D. degree will depend upon the needs and interests of the individual.

### **Transfer Credit**

If transfer credit for doctoral work is desired, approval of such credit must be given by the Director of the Ph.D. program. A maximum of 12 quarter hours of graduate credit obtained at a recognized institution are accepted, provided that the credits transferred are in the candidate's field, consist of work taken at a graduate level for graduate credit, and carry grades of A or B. Students should petition the Director of the Graduate School of Pharmacy and Allied Health Professions in writing for all transfer credit.

### **Dissertation**

Each doctoral student must complete a dissertation which embodies the results of extended research and which makes an original contribution to the field. This work should give evidence of the candidate's ability to conduct independent investigation and to interpret the results of his research in an acceptable manner.

Selection of a thesis adviser must be made within four months of the student's completion of the entrance examinations. An adviser is selected by mutual consent of the student and a member of the faculty in the Department of Medicinal Chemistry and Pharmacology. It is expected that the student will begin his research and demonstrate satisfactory proficiency in the laboratory prior to the qualifying examination.

The thesis adviser serves as Chairman of the Thesis Committee, which consists of not less than three members. Individuals are chosen for expertise in the student's area of research. His research progress is evaluated by this Committee, meeting no less than twice a year. Low productivity or unsatisfactory work provides the basis for warning by this Committee. Two such warnings result in a student's dismissal from the program at any stage.

### **Foreign Language**

A reading knowledge of one foreign language (French, German, or Russian) is required. The Thesis Committee prescribes the manner in which proficiency in the language is determined.

### **Research Proposal Defense**

After completion of the qualifying examination, and prior to the final oral, the student, with the approval of the Thesis Committee, prepares a written

proposal in an area distinctly different from his thesis. He then defends it orally before this Committee.

### **Final Oral Examination**

The final oral examination is taken after the completion of all other requirements for the degree. This examination must be held at least three weeks before the commencement at which the degree is to be awarded.

The Thesis Committee conducts the final oral examination. The Director of the Graduate School of Pharmacy and Allied Health Professions, together with the Department Chairman and the thesis adviser, appoint any additional members to this Committee which they consider necessary.

The final oral examination deals with the subject matter of the doctoral dissertation, significant developments in the field of the dissertation, and the student's background knowledge in his field of specialization.

### **Time Limitation**

After the establishment of degree candidacy, a maximum of five years is allowed for completion of the degree requirements.

### **Registration**

All students must register in the Registrar's Office for course work or dissertation as approved by the faculty adviser. Students must be registered for the dissertation during the quarter in which they take the final oral examination.

### **Curriculum Design**

The graduate school recognizes the divergent backgrounds and goals for individuals who may be accepted into this program. Accordingly, the program is designed to offer flexibility in course selection so as to maximize its relevance to the student's career objective.

## **INTERDISCIPLINARY PROGRAMS**

Some graduate students may wish to pursue doctoral programs which involve substantial work in two or more departments. To meet this need, an interdisciplinary program may be established which corresponds in scope and depth to doctoral standards, but which does not agree exactly with the individual departmental regulations. For such possibilities, the following option is available.

### **Admission**

Application for admission to interdisciplinary doctoral study consists of the submission of a carefully thought-out, written proposal describing the areas of projected study and research. The proposal may be a part of the

initial application for admission to graduate study at Northeastern University, or it may be submitted by a student already enrolled. It may be directed to a doctoral degree-granting department or to the Director of the Graduate School, who will then forward it to the appropriate department. In either case, admission to interdisciplinary doctoral study requires favorable recommendation by the sponsoring doctoral degree-granting department and approval by the Graduate Committee of the Graduate School of Pharmacy and Allied Health Professions.

### **Formation of Interdisciplinary Committee**

A student who has been accepted for interdisciplinary study must obtain the consent of an adviser who will direct his doctoral dissertation. This adviser, who may or may not be a member of the sponsoring department, serves as Chairman of the Interdisciplinary Committee for this student. A second member is appointed from the sponsoring department by its chairman. These two members obtain one or more additional members or request the Director of the Graduate School of Pharmacy and Allied Health Professions to do so. At least two departments must be represented on the committee, and a majority of the committee members must come from doctoral degree-granting departments. The chairman of the sponsoring department notifies the Director of the Graduate School of the committee membership as soon as possible.

### **Duties of Interdisciplinary Committee**

A member of the Interdisciplinary Committee who is also a member of the sponsoring department serves as the registration officer to approve the student's course registration. A copy of the approved course registration must also be filed with the other committee members and with the Graduate Committee.

The Interdisciplinary Committee is responsible for the administration of the qualifying examination, language examination, approval of the dissertation, and comprehensive examination. This Committee must also certify to the sponsoring department the completion of the requirements for the doctoral degree.

The Interdisciplinary Committee must be assured that the student's program represents standards comparable to those of the sponsoring department and that the program is not so broad that it has inadequate depth in any area. The Director of the Graduate School may review the program at any time to determine whether its objectives are being met.

# financial information

## FINANCIAL OBLIGATIONS

### Tuition

Tuition rates are subject to revision by the Board of Trustees and may change year by year. The current rate is stated in a covering letter for the specific year and program.

Doctoral candidates actively utilizing the resources of the University in their Ph.D. dissertation are charged an additional \$600 per quarter. Those doctoral candidates registered for dissertation work performed off campus are charged \$200 in addition to tuition charges each quarter, and those doctoral candidates who are no longer actively utilizing University resources are charged a continuation fee of \$50 per quarter.

Tuition statements are mailed to students by the Bursar's Office and are payable by check to Northeastern University.

### Fees

All students are charged an application fee of \$15 when they apply for the first time to a graduate school at Northeastern University.

Other fees include a charge of \$10 for late payment of tuition and a fee of \$25 for all degree candidates, payable before commencement by the applicable date listed on the academic calendar.

For full-time students there is a charge of \$12.50 per quarter for the services available in the Student Center. For teaching assistants and research fellows, the fee is \$6.25 per quarter. All part-time students on the Huntington Avenue Campus are charged 75 cents per quarter.

All full-time students pay a nonrefundable University Health Services fee of \$120 each year. This fee provides Blue Cross-Blue Shield coverage and entitles the student to the medical care furnished by the University Health Services. Tuition and fees are subject to change without notice.

All financial obligations to the University must be discharged prior to graduation.

### Refunds

Tuition refunds are granted only on the basis of the date appearing on the student's official withdrawal form. Nonattendance does not constitute official withdrawal. Questions regarding refunds should be directed to the Bursar's Office.

Refunds are granted in accordance with the following schedule:

Official Withdrawal Filed Within:	Percentage of Tuition:
First week of quarter	100
Second week of quarter	75
Third week of quarter	50
Fourth week of quarter	25

### **FINANCIAL AID**

Northeastern University offers fellowships and assistantships for full-time students who are working toward the doctor's degree. They may establish candidacy for these awards by completing the relevant section of the application for admission. Students already enrolled should consult their departmental adviser. There is no financial aid available for the Master of Science programs or for those students enrolled in the Special Student category. Those individuals auditing any course must remit full tuition.

The University does not award financial assistance in any form to students who are not citizens or permanent residents of the United States.

#### **Tuition Assistantships**

The College of Pharmacy and Allied Health Professions provides remission of tuition to full-time students assisting eight hours a week in departmental administrative work.

#### **Teaching Assistantships**

Teaching Assistantships allowing remission of tuition and a stipend are available to Ph.D. candidates in Medicinal Chemistry. Those holding such awards devote half time to academic assistance directly related to the teaching function and the balance to course work.

#### **Research Fellowships**

Research fellowships, including those supported by the National Institutes of Health, carry a stipend and remission of tuition. Certain of these grants require half-time work on research in the department, with the remaining time devoted to course work. Others provide for full-time work on dissertation research. Availability of such fellowships depends upon the receipt of grants or contracts by departmental faculty members.

#### **Martin Luther King, Jr., Scholarships**

Established in 1969 in memory of the late Rev. Martin Luther King, Jr., awards are made as openings occur to qualified minority graduate students who show financial need and are accepted to full-time study in the graduate schools of the University. Stipends cover tuition and all fees.



## **Appointments**

Appointments to fellowships and assistantships are ordinarily announced no later than April 15 for the following academic year or summer. Appointments are for a maximum of three academic quarters and are not automatically renewed. Students who hold assistantships and research fellowships are expected to devote full time to their studies and the duties of the award. They may not accept outside employment without the consent of their faculty adviser and the Director of the Graduate School.

## **Dormitory Proctorships**

A number of proctorships for men and women in dormitories on or near the Huntington Avenue Campus are available each year. Appointments carry a minimum compensation of room and board. Further information and applications may be obtained from the Office of University Housing.

## **Guaranteed Insured Loan Program**

These loans are available through lending institutions in the applicant's home area. Under this program a student may borrow as much as \$2,500 per academic year to a maximum indebtedness of \$10,000. Repayment of principal and interest need not begin until nine months after the termination of studies.

The student must have submitted, through the College Scholarship Service, a Parents' Confidential Statement or, if he has been declared financially independent by the Financial Aid Office, a Student's Confidential Statement. These forms are available in the Financial Aid Office.

Applications for the loan itself are available from local banks or the Education Office of your state government. The Financial Aid Office has additional information and necessary application forms for Massachusetts residents.

## **National Direct Student Loan Program**

This program is available to students who are carrying at least one half the normal academic load, are accepted as degree candidates, and show evidence of financial need.

The maximum amount which may be borrowed in any academic year is \$2,500, and the total of the loans must not exceed \$10,000.

Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load at an institution of higher education. The repayment of principal may be extended over a 10-year period with the interest at the rate of three percent per annum. Repayment may be deferred up to a total of three years while a borrower is serving as a Peace Corps or VISTA Volunteer.

Additional information and application forms are available from the Office of Financial Aid. The application deadline is September 1 for full-time students. For other students the deadline is six weeks prior to the start of the quarter for which aid is requested.

# faculty

## GRADUATE FACULTY

### Professors

- Arnold S. Goldstein, B.S. in Pharmacy, J.D., *Professor of Pharmacy Administration*
- O. James Inashima, Ph.D., *Professor of Pharmacology and Acting Chairman, Department of Pharmacy and Pharmacy Administration*
- Barry L. Karger, Ph.D., *Professor of Chemistry and Medicinal Chemistry and Director of the Institute of Chemical Analysis, Applications, and Forensic Science*
- Helene A. Loux, Ph.D., M.T. (ASCP), *Associate Dean and Professor of Health Sciences*
- John L. Neumeyer, Ph.D., *Professor of Medicinal Chemistry and Acting Chairman, Department of Medicinal Chemistry and Pharmacology*
- Robert F. Raffauf, Ph.D., *Professor of Pharmacognosy and Medicinal Chemistry*
- Albert H. Soloway, Ph.D., *Director of the Graduate School of Pharmacy and Allied Health Professions and Dean, College of Pharmacy and Allied Health Professions*
- Elliot Spector, Ph.D., *Professor of Pharmacology*
- John W. Webb, M.S., *Clinical Professor of Pharmacy*

### Associate Professors

- Andrew T. Canada, Ph.D., *Clinical Associate Professor of Pharmacy*
- Michael A. Davis, D.Sc., *Clinical Associate Professor of Medicinal Chemistry*
- William A. Gouveia, M.S., *Clinical Associate Professor of Pharmacy*
- James J. Gozzo, Ph.D., *Associate Professor of Health Sciences*
- Alun G. Jones, Ph.D., *Clinical Associate Professor of Medicinal Chemistry*
- Britta L. Karlsson, M.S., M.T. (ASCP), *Associate Professor of Health Sciences (Medical Laboratory Science)*
- Victor D. Warner, Ph.D., *Associate Professor of Medicinal Chemistry*

### Assistant Professors

- Judith Barr, M.Ed., M.T. (ASCP), *Assistant Professor of Health Sciences (Medical Laboratory Science)*
- Jeffrey B. Blumberg, Ph.D., *Assistant Professor of Pharmacology*
- Gerald L. Davis, M.T., Ph.D., *Assistant Professor of Health Sciences*
- Catherine W. Hallsworth, M.S., M.T., (ASCP), *Assistant Professor of Health Sciences (Medical Laboratory Science)*

Bynum M. Jackson, Ph.D., M.T. (ASCP), *Assistant Professor of Health Sciences (Medical Laboratory Science)*  
 Jerome P. Janousek, M.S., *Clinical Assistant Professor of Pharmacy*  
 Donald S. Kosersky, Ph.D., *Assistant Professor of Pharmacology*  
 B. Susan Rogers, M.S., M.T. (ASCP), *Assistant Professor of Health Science (Medical Laboratory Science)*  
 Joseph M. Sceppa, M.S., *Clinical Assistant Professor of Pharmacy*  
 Richard T. Scheife, Pharm. D., *Clinical Assistant Professor of Pharmacy*  
 Leon D. Shargel, Ph.D., *Assistant Professor of Pharmacy and Pharmacology*  
 Albert H. Taubman, Ph.D., *Assistant Professor of Pharmacy Administration*

### **Adjunct Faculty**

Khalid Butt, M.D., *Special Lecturer in Clinical Laboratory Science*  
 Howard Christian, M.D., *Special Lecturer in Clinical Laboratory Science*  
 Bradley Copeland, M.D., *Adjunct Professor of Health Sciences*  
 John F. Howes, Ph.D., *Lecturer in the Department of Medicinal Chemistry and Pharmacology*  
 Herbert L. Kayne, Ph.D., *Lecturer in Health Sciences*  
 Agnes Kim, M.D., *Special Lecturer in Clinical Laboratory Science*  
 George M. Krause, *Adjunct Professor of Pharmacy*  
 Manlio A. LoConte, M.D., *Lecturer in the Department of Medicinal Chemistry and Pharmacology*  
 Arnold Marglin, M.D., Ph.D., *Lecturer in Health Sciences*  
 Randi Rosvall, M.D., *Special Lecturer in Clinical Laboratory Science*  
 Andre Rosowsky, Ph.D., *Lecturer in the Department of Medicinal Chemistry and Pharmacology*

### **ADMINISTRATIVE POSITIONS**

Albert H. Soloway, *Director of the Graduate School of Pharmacy and Allied Health Professions*  
 Carol M. Konis, *Administrative Assistant*  
 Michael A. Davis, *Director of the Master of Science Degree Program in Radiopharmaceutical Science*  
 Roger W. Giese, *Director of the Master of Science Degree Program in Clinical Chemistry*  
 James J. Gozzo, Ph.D., *Director of the Master of Science Degree Program in Medical Laboratory Science (Effective July 1, 1976)*  
 Helene A. Loux, *Director of the Master of Science Degree Program in Medical Laboratory Science*  
 John L. Neumeyer, *Director of the Doctor of Philosophy Degree Program in Medicinal Chemistry*  
 Robert F. Raffauf, *Director of the Master of Science Degree Program in Medicinal Chemistry*  
 John W. Webb, *Director of the Master of Science Program in Hospital Pharmacy*

# fields of study

The sections that follow list degree programs and courses available to a student during the typical period of attendance required to obtain each degree. The place and time for which a specific course is offered may be found in the course announcement made available in May for the summer quarter and in June for the following academic year.

## **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN CLINICAL CHEMISTRY**

### **Objectives**

At the present time, there is an acute shortage of trained people in clinical chemistry. This is especially critical in view of the increasing need for individuals with in-depth training in the chemical and biological sciences to direct clinical laboratory personnel.

Northeastern offers a part-time, evening Master of Science degree program in Clinical Chemistry under the joint sponsorship of the Department of Chemistry and the Graduate School of Pharmacy and Allied Health Professions. The program is available to people currently practicing clinical chemistry or those with appropriate backgrounds who wish to train for this field.

The development of this program came about through careful deliberation by members of the Departments of Chemistry, Medicinal Chemistry and Pharmacology, and Medical Laboratory Sciences. Thus, it is a truly interdisciplinary offering, representing a composite of the skills and knowledge of each of these disciplines. It is one of a series of graduate programs designed to meet the frequently expressed needs of clinical pathologists.

### **Admission and Program Features**

The Admissions Committee for this program is composed of three faculty members: two from the Department of Medicinal Chemistry and Pharmacology and a third from Medical Laboratory Sciences. The Committee evaluates the background of the applicants, suggests course sequences, and informs the students of those offerings which will maximize their background in clinical chemistry.

For admission to this part-time M.S. degree program, the applicant must have completed a baccalaureate program in biology, chemistry, medical technology, pharmacy or a related field. Undergraduate requirements are: a minimum of two quarters of organic chemistry, two quarters of analytical chemistry, each with a laboratory or its equivalent, two quarters of human

physiology, and two quarters of physical chemistry. An individual who has deficiencies in any of these areas may take appropriate courses at Northeastern University concurrently with those graduate courses which do not require the deficient prerequisites. The appropriate evening courses offered at University College of Northeastern University are: Analytical Chemistry, 12.521 - 12.526; Organic Chemistry, 12.531 - 12.533; Physical Chemistry, 12.541 - 12.543; and Human Anatomy and Physiology, 18.524 - 18.526. Equivalent courses are accepted from this University or other accredited universities. Students admitted with deficiencies must remove them during the first 12 quarter hours of graduate work. By the completion of the degree requirements, students must have at least one year of acceptable clinical laboratory experience subsequent to attaining the appropriate baccalaureate degree.

Students in good standing in the program who lack this experience requirement may apply for an applied (training) course in clinical chemistry. This course is offered through the Graduate School of Pharmacy and Allied Health Professions of Northeastern University at one of the nearby affiliated hospitals and provides three months of this experience requirement. Individuals who have completed this course achieve an enhanced opportunity to obtain subsequent employment in this field and thereby satisfy the one year of experience requirement.

The program is available on a part-time basis, with courses offered primarily during the evening hours. Courses are scheduled in the fall, winter, spring, and summer quarters. It is anticipated that students may complete the degree requirements in a minimum of three years; however, the duration may sometimes be increased or decreased to satisfy the particular needs and requirements of the student. No research report or thesis is required.

## Curriculum

<i>Required Courses</i>	<i>Credits</i>
12.821 Analytical Separations	2
12.823 Optical Methods of Analysis	2
72.834 Clinical Chemistry I	2
72.835 Clinical Chemistry II	2
72.837 Seminar and Report in Clinical Chemistry*	2
73.845 Radioisotopes in Biological Systems	2
87.807 Biometrics	2
87.810 Functions of the Human Systems	2
90.821 Biochemistry I	2
90.822 Biochemistry II	2
90.823 Biochemistry III	<u>2</u>
QUARTER HOURS	22

\*The first quarter of 72.837 is a required course; however, the course may be repeated twice as an elective.

*Elective Core*

A minimum of 12 credits must be taken from the following list:

12.822	Electroanalytical Chemistry	2
12.824	Special Topics in Analytical Chemistry I	2
12.825	Special Topics in Analytical Chemistry II	2
12.827	Computers in Chemistry	2
12.828	Chemical Instrumentation	2
72.836	Protein Analysis	2
72.837	Seminar and Report in Clinical Chemistry	2
72.861	CNS Depressants	2
72.862	Autonomic Drugs	2
72.863	Anti-infectives	2
72.864	Cancer Therapy and Carcinogenesis	2
72.865	Special Topics in Medicinal Chemistry	2
73.816	Concepts in Toxicology I	2
73.817	Concepts in Toxicology II	2
73.844	Drug Metabolism	2
87.811	Pathophysiology I	2
87.812	Pathophysiology II	2
87.833	Immunobiology	2
87.890	Seminar	1
90.824	Applications of Mass Spectrometry	2

*Elective Courses*

Taken with the approval of the Director of the M.S. program in Clinical Chemistry and the course instructor. Selection may be made from the above courses, as well as from the following and other appropriate graduate courses in the Graduate School of Pharmacy and Allied Health Professions or in the rest of the University.

11.871	Radiation Physics	2
11.872	Radiobiology	2
12.841	Inorganic Chemistry I	2
12.842	Inorganic Chemistry II	2
12.846	Coordination Chemistry	2
12.861	Advanced Organic Chemistry I	2
12.862	Advanced Organic Chemistry II	2
12.863	Physical Organic Chemistry	2
12.866	Spectrometric Identification of Compounds	2
12.881	Thermodynamics I	2
12.885	Atomic and Molecular Structure I	2
12.893	Kinetics	2
18.245	Serology-Immunology	3
18.840	Comparative Physiology of Regulatory Mechanisms	2
18.842	Vertebrate Endocrinology	2
18.843	Procedures in Endocrinology	3
18.860	Cell Biophysics and Biochemistry	5

18.909	Animal Virology	4
18.940	Microbial Biochemistry	4
72.837	Seminar and Report in Clinical Chemistry	2
72.815	Nuclear Medicine I	2
72.816	Nuclear Medicine II	2
72.817	Nuclear Medicine III	2
72.818	Nuclear Medicine IV	2
72.844	Seminar and Research Report in Radiopharmaceutical Science	2
72.866	Phytochemistry	2
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.818	Special Topics in Pharmacology	2
87.802	Advanced Medical Laboratory Science — Hematology and Immunohematology	4

A minimum total of 40 quarter hours of graduate credit is necessary for completion of the M.S. degree in Clinical Chemistry.

**SAMPLE PROGRAM**  
**MASTER OF SCIENCE IN CLINICAL CHEMISTRY**  
 (Required Courses and Possible Electives)

**YEAR 1**

**Fall Quarter**  
 87.810 Functions of Human Systems  
 90.821 Biochemistry I

**Winter Quarter**  
 2 73.844 Drug Metabolism  
 2 90.822 Biochemistry II

**Spring Quarter**  
 2 12.823 Optical Methods of Analysis  
 2 90.823 Biochemistry III

**Fall Quarter**  
 12.821 Analytical Separations  
 72.834 Clinical Chemistry I

**Winter Quarter**  
 2 12.822 Electroanalytical Chemistry  
 2 72.835 Clinical Chemistry II

**Spring Quarter**  
 2 72.836 Protein Analysis  
 2 73.845 Radioisotopes in Biological Systems

**Fall Quarter**  
 12.827 Computers in Chemistry  
 87.807 Biometrics

**Winter Quarter**  
 2 72.837 Seminar and Report in Clinical  
 Chemistry I  
 87.811 Pathophysiology I  
 Elective

**Spring Quarter**  
 72.864 Cancer Therapy and Carcinogenesis  
 2 87.812 Pathophysiology II  
 2 87.833 Immunobiology  
 2

**Fall Quarter**  
 11.871 Radiation Physics  
 12.824 Special Topics in Analytical  
 Chemistry I  
 12.827 Computers in Chemistry  
 12.861 Advanced Organic Chemistry  
 12.881 Thermodynamics I  
 72.863 Anti-infectives  
 72.866 Phytochemistry  
 73.814 Concepts in Pharmacology I  
 87.802 Advanced MLS Hematology and  
 Immunohematology  
 87.890 Seminar

**Winter Quarter**  
 2 11.872 Radiobiology  
 12.822 Electroanalytical Chemistry  
 2 12.825 Special Topics in Analytical  
 Chemistry II  
 2 12.828 Chemical Instrumentation  
 2 12.862 Advanced Organic Chemistry II  
 2 12.885 Atomic and Molecular Structure I  
 2 72.815 Nuclear Medicine I  
 2 72.817 Nuclear Medicine III  
 2 72.862 Autonomic Drugs  
 4 73.815 Concepts in Pharmacology II  
 1 73.816 Concepts in Toxicology I

**Spring Quarter**  
 2 12.825 Special Topics in Analytical  
 Chemistry II  
 2 12.846 Coordination Chemistry  
 2 12.893 Kinetics I  
 2 72.816 Nuclear Medicine II  
 2 72.818 Nuclear Medicine IV  
 2 72.844 Seminar and Research Report in  
 Radiopharmaceutical Science  
 2 72.861 CNS Depressants  
 2 73.817 Concepts in Toxicology II  
 2 87.812 Pathophysiology II  
 2

**Summer Quarter**

72.865 Special Topics in Medical  
 Chemistry  
 90.824 Applications of Mass  
 Spectrometry

2  
2



## **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN HOSPITAL PHARMACY**

### **Objectives**

Institutional pharmacy will constitute a major form of professional practice within the next decade. The pharmacist practicing in this environment must show proficiency in both the administrative and therapeutic spheres. The administrative need is essential, since the director of a hospital pharmacy must have managerial competence in order to direct personnel, determine budgets, interact with hospital administration and other departments, and establish guidelines and objectives for the pharmacy. It is his responsibility to determine the goals and the means for integrating the pharmacy into a high-quality health delivery system.

Additionally, he must be completely knowledgeable of the most modern therapeutic maneuvers, especially as they relate to the preparation and use of drugs. This is the pharmacist's area of expertise. The physician, nurse, and other medical personnel depend upon the modern pharmacist to counsel them in drug usage and selection, contraindication of drugs with specific disease conditions, and problems encountered with drug interactions. His guidance is essential and can only be based upon a comprehensive knowledge of therapeutics.

The function of this program is to prepare the modern pharmacist for such a career in institutional practice.

### **Admission and Program Features**

The Director of the M.S. program in Hospital Pharmacy serves as Chairman of the Admissions Committee. The function of this Committee is to evaluate the background of the applicants and advise the Graduate Committee of their suitability for admission to the program. Additionally, the Director guides the graduate students in course selection and apprises them of those offerings which maximize their individual educational goals.

Admission as a matriculated graduate student is limited to those who possess a B.S. degree in Pharmacy (or an equivalent degree in Pharmacy) from an accredited college of pharmacy. The candidate must have demonstrated an ability to pursue graduate studies as evidenced by undergraduate transcripts and/or other evidence of scholarship.

The program is available on a part-time basis, with courses offered primarily during the evening hours. Courses are scheduled in the fall, winter, and spring quarters. It is anticipated that students may complete the degree requirements in a minimum of three years; however, the duration may in some cases be increased or decreased to satisfy the particular needs and requirements of the student. No research report or thesis is required.

## Curriculum

The program contains a core curriculum of 12 quarter-hour credits of required courses and 12 quarter-hour credits to be selected from an elective core consisting of six hours of administrative courses and six hours of therapeutic courses. The total of the required and elective core components is 24 quarter hours of credit. In addition, 16 hours are to be selected from those graduate courses offered by divisions in the University. These latter courses are to be selected with the guidance of the Director of the M.S. program in Hospital Pharmacy.

<i>Required Courses</i>		<i>Credits</i>
71.815	Biopharmaceutics and Pharmacokinetics	2
71.822	Project Seminar and Report in Hospital Pharmacy	2
71.844	Hospital Pharmacy Administration I	2
71.845	Hospital Pharmacy Administration II	2
71.846	Hospital Pharmacy Administration III	2
71.854	Clinical Pharmacy	2
QUARTER HOURS		12

### *Elective Core*

#### Administrative Core

71.823	Legal Aspects/Federal Legislation in Pharmacy	2
71.852	Health Care Administration I	2
71.853	Health Care Administration II	2
71.855	Human Relations	2
71.856	Information Science in Hospital Pharmacy	2
QUARTER HOURS		6

#### Therapeutic Core

71.858	Contemporary Therapeutics I	2
71.859	Contemporary Therapeutics II	2
71.860	Drug Monitoring	2
71.861	Sterile Products	2
71.862	Hospital Preparations	2
QUARTER HOURS		6

Total Required Courses and Elective Core	24
Electives	16
TOTAL PROGRAM ( <i>quarter hours</i> ):	40

*Elective Courses*

Taken with the approval of the Director of the M.S. program in Hospital Pharmacy and the course instructor. No more than 10 quarter hours of credit may be taken from programs other than those offered by the Graduate School of Pharmacy and Allied Health Professions.

5.860	Health Care Organization and Management	2
5.913	Data Processing	2
21.840	Sociology of Medicine	3
21.850	Sociology of Occupations and Professions	3
22.868	Politics and Health Care Administration	3
39.9H1	Economics of Medical Care and Health Manpower	3
41.811	Financial and Managerial Accounting	3
41.816	Management Control of Health Service Systems	3
43.814	Consumer Behavior	3
45.811	Purchasing and Materials Management	3
45.816	Organizational Behavior I	3
45.817	Organizational Behavior II	3
45.824	Organizational Behavior in a Nonprofit Environment	3
45.833	Operations Management in the Health Care System	3
45.838	Policy Formation in Health Care	3
45.951	Executive Development	3
45.972	Labor Relations	3
45.977	Information Systems for Health Care Facilities	3
45.978	Regulation and the American Health Care Industry	3
45.979	Integrative Models in Health Care	3
50.807	Abnormal Psychology	4
63.814	Grantsmanship	4
71.816	Clinical Pharmacokinetics	2
72.834	Clinical Chemistry I	2
72.835	Clinical Chemistry II	2
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.816	Concepts in Toxicology I	2
73.817	Concepts in Toxicology II	2
73.844	Drug Metabolism	2
73.845	Radioisotopes in Biological Systems	2
87.811	Pathophysiology I	2
87.812	Pathophysiology II	2

**SAMPLE PROGRAM**  
**MASTER OF SCIENCE IN HOSPITAL PHARMACY**

## YEAR 1

Fall Quarter

71.844	Hospital Pharmacy Administration
71.854	Clinical Pharmacy

Winter Quarter

2	71.845	Hospital Pharmacy Administration II
2	71.858	Contemporary Therapeutics I

## Spring Quarter

2	2	71.846	Hospital Pharmacy Administration III	2
2	2	71.859	Contemporary Therapeutics II	2

## Summer Quarter

71.822 Project Seminar and Research Report  
in Hospital Pharmacy

YEAR 2

## Fall Quarter

71.852	Health Care Administration I
71.860	Drug Monitoring

*Winter Quarter*

2	71.853	Health Care Administration
2	71.861	Sterile Products

## Spring Quarter

2	71.855	Human Relations
2	71.862	Hospital Preparations

*Fall Quarter*

71.815	Biopharmaceutics and Pharmacokinetics
71.823	Legal Aspects/Federal Legislation in Pharmacy

Winter Quarter

71.856 Information Science in Hospital Pharmacy Electives

## Spring Quarter

Electives 6

YEAR 3

Fall Quarter

5.860	Health Care Organization and Management
41.816	Management Control of Health Service Systems
72.834	Clinical Chemistry I
63.814	Grantmanship
73.814	Concepts in Pharmacology I

Winter Quarter

39.9H1	Economics of Medical Care and Health Manpower	2
72.835	Clinical Chemistry II	2
73.815	Concepts in Pharmacology II	3
73.816	Concepts in Toxicology I	2
73.844	Drug Metabolism	4
72.871	Pathophysiology I	2

## Spring Quarter

71.816	Clinical Pharmacokinetics	2
73.845	Radioisotopes in Biological Systems	2
73.817	Concepts in Toxicology II	2
87.812	Pathophysiology II	2

## Summer Quarter

5.913 Data Processing  
45.838 Policy Formation in  
Health Care

## **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN MEDICAL LABORATORY SCIENCE**

### **Objectives**

This program provides opportunity for medical laboratory scientists to acquire increased expertise in laboratory science and in clinical laboratory research and development.

The graduate of this program will contribute significantly to the modern medical laboratory. He should be able to search the literature to find and test available methodologies, and to develop, modify, and evaluate new methods. He should be a qualified associate in the clinical pathology department. The graduate courses in administration and education prepare the student for administrative or teaching responsibilities required in medical laboratory supervisory or educative positions.

### **Admission and Program Features**

To be enrolled for graduate work, the applicant must hold a baccalaureate degree from a recognized institution and provide evidence that he is able to pursue a program of graduate study as determined by the Graduate Committee. His scholastic record must show distinction, with adequate preparation in the sciences, including one year of organic chemistry, college physics, and mathematics; one complete course of analytical chemistry; and a minimum of 24 quarter hours or the equivalent of biological sciences including basic microbiology, human physiology, genetics, and cell biology. Requirements in human physiology, genetics, and cell biology may be completed at the graduate level. Students admitted with deficiencies must remove them during the first 20 quarter hours of graduate work.

Acceptance to the school is upon recommendation of the Medical Laboratory Science Graduate Committee and approval by the Graduate Committee of the Graduate School of Pharmacy and Allied Health Professions. It is anticipated that students may complete the degree requirements in a minimum of three years. However, in some cases this may be increased or decreased to satisfy a student's particular needs and requirements.

### **Professional Requirement**

At the completion of the Master of Science degree, the student must have written, or be eligible to write, the examination in medical technology or in one of the categorical or specialist certifications of the Board of Registry of the American Society of Clinical Pathologists. Students intending to complete their professional requirements in an approved hospital school of medical technology must also make direct application to the hospital program. Acceptance to the graduate program in medical laboratory science does not imply concomitant acceptance to a hospital program.

## Curriculum

The program contains a core curriculum of 27 quarter-hour credits of required courses and eight quarter-hour credits selected from an elective core. In addition, eight hours are to be selected from those graduate courses offered by the Graduate School of Pharmacy and Allied Health Professions or by other divisions in the University. These latter courses are to be selected with the guidance of the Director of the M.S. program in Medical Laboratory Science. A total of 43 quarter hours of academic work are required for this program.

In addition to the required course 87.990 Research Report I, each student working toward the degree of Master of Science in Medical Laboratory Science may elect to take either 87.991 Research Report II (2-4 quarter hours of credit) or 87.992 MLS Thesis (6 quarter hours of credit). After initial election of either 87.991 or 87.992, students must register for the selected course each quarter until work is completed. Grades for 87.990, 87.991 and 87.992 are recorded as Satisfactory or Unsatisfactory. Two unsatisfactory grades result in the student's dismissal from the thesis portion of the program.

The research report may take the form of a comprehensive, critical review of the literature in a specialized area and/or a specific program of experimental work on a single topic. If experimental work has been elected for Research Report II, it may be expanded later, with the permission of the student's research advisor, into a master's thesis with a topic, advisor and committee composed of not less than three members. Research Report II will culminate in a comprehensive, well-written report which must be reviewed by three faculty members. MLS Thesis will culminate in a final oral examination.

A comprehensive examination is required of all students, except those presenting a thesis. This exam will be offered once yearly on a pass/fail basis. Students failing the examination are given one opportunity to remove this failure.

<i>Required Courses</i>	<i>Credits</i>
87.801 Advanced Medical Laboratory Science — Pathogenic Microbiology	4
87.802 Advanced Medical Laboratory Science — Hematology and Immunohematology	4
87.805 Advanced Medical Laboratory Science — Chemistry and Instrumentation	4
87.807 Biometrics	2
87.811 Pathophysiology I	2
87.812 Pathophysiology II	2
87.990 Graduate Research Report I	2
90.821 Biochemistry I	2
90.822 Biochemistry II	2
Seminars (3): 1 quarter hour each (87.890 or from other graduate programs)	<u>3</u>
QUARTER HOURS	27

Students who are registered M.T. (ASCP) and who have completed the equivalent of 87.801, 87.802 and 87.805 within the previous five years, and are currently working in the speciality, should petition to substitute appropriate graduate science courses. Approval of advisor is required.

### *Elective Core*

A minimum of eight credits must be taken from the following list:

18.240	Microbial Physiology	4
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.845	Radioisotopes in Biological Systems	2
87.821	Medical Laboratory Management I	2
87.826	Health Science Education I	2
87.832	Hematology I	2
87.833	Immunobiology	2
87.845	Epidemiology	2
87.858	Cellular Pathology	2
90.823	Biochemistry III	2

### *Elective Courses*

Selection may be made from other courses in the electives core or from the following. Students may choose all electives in one area; i.e., the laboratory sciences, health science education, or laboratory administration.

18.211	Parasitology	4
18.242	Medical Microbiology	2
18.245	Serology — Immunology	3
18.246	Serology — Immunology Laboratory	2
18.903	Environmental Microbiology	4
18.905	Marine Microbiology	4
18.907	Food Microbiology	2
18.909	Animal Virology	4
18.910	Microbial Genetics	3
18.915	Medical Mycology	2
18.940	Microbial Biochemistry	4
19.838	Human Learning and Cognition	3
21.840	Sociology of Medicine	3
21.843	Sociology of Education	3
21.847	Formal Organizations	3
21.850	Sociology of Occupations and Professions	3
21.910	The Sociology of Science	3
22.876	Administrative Behavior	3
22.879	Science, Technology and the Administration of Public Policy	3
39.9G7	Public Policy in Manpower	3

# **SAMPLE PROGRAM** MASTER OF SCIENCE IN MEDICAL LABORATORY SCIENCE

<b>Fall Quarter</b>		<b>YEAR 1</b>		<b>Spring Quarter</b>	
87.802	Advanced MLS Hematology and Immunohematology	4	87.805	Advanced MLS Clinical Chemistry Elective (i.e. 87.803)	4
				87.801	Advanced MLS Pathogenic Microbiology Elective (i.e. 87.804)
				2	2
<b>Fall Quarter</b>		<b>YEAR 2</b>		<b>Spring Quarter</b>	
87.807	Biometrics	2	87.811	Pathophysiology I	2
90.821	Biochemistry I	2	90.822	Biochemistry II	2
				87.890	Seminar
					Elective
					1
<b>Fall Quarter</b>		<b>YEAR 3</b>		<b>Spring Quarter</b>	
87.990	Graduate Research Report I	2	87.890	Seminar	1
	Elective	2		Elective	2
	Seminar	1		Elective	2



## ELECTIVES

### Fall Quarter

18.211	Parasitology	4
18.910	Microbial Genetics	3
18.909	Animal Virology	4
50.815	Research Design in Education	2
72.834	Clinical Chemistry I	2
72.863	Anti-Infectives	2
87.802	Advanced MLS Hematology and Immunohematology	2
87.803	Medical Immunology and Serology	2
87.807	Biometrics	2
87.810	Functions of the Human Systems	2
87.826	Health Science Education I	2
87.990	Graduate Research Report I	2
87.991	Graduate Research Report II	2-4

### Summer Quarter

18.903	Environmental Microbiology	4
18.905	Marine Microbiology	4
50.815	Research Design in Education	4
87.817	Immunohematology Administration	4
87.818	Transfusion Therapy	4
87.990	Graduate Research Report I	2
87.991	Graduate Research Report II	2-4

### Winter Quarter

18.211	Parasitology	4
18.242	Medical Microbiology	3
18.245	Immunology and Serology	4
18.246	Immunology and Serology Laboratory	2
39.9H1	Economics of Medical Care and Health Manpower	2
50.815	Research Design in Education	2
50.817	Research Problems in Education	2
71.852	Health Care Administration I	2
72.835	Clinical Chemistry II	2
73.816	Concepts in Toxicology I	2
73.844	Drug Metabolism	2
87.804	Medical Parasitology	2
87.805	Advanced MLS Clinical Chemistry and Instrumentalism	2-4
87.811	Pathophysiology I	4
87.813	Genetic and Immunological Aspects of Blood Group Identification	4
87.814	Principles and Foundations of the Blood Group Syst.	4
87.821	Medical Laboratory Management I	4
87.827	Health Science Education II	4
87.845	Epidemiology	2
87.990	Graduate Research Report I	2-4
87.991	Graduate Research Report II	2-4

### Spring Quarter

18.903	Environmental Microbiology	4
18.905	Marine Microbiology	4
18.907	Food Microbiology	2
18.915	Medical Mycology	2
18.940	Microbial Biochemistry	4
19.838	Human Learning and Cognition	3
21.840	Sociology of Medicine	3
22.876	Administrative Behavior	3
39.9G7	Public Policy in Manpower	3
50.815	Research Design in Education	2
71.853	Health Care Administration II	2
72.864	Cancer Therapy and Carcinogenesis	2
73.817	Concepts in Toxicology II	2
73.818	Special Topics in Pharmacology	2
87.801	Advanced MLS Pathogenic Microbiology	4
87.812	Pathophysiology II	2
87.815	The Design and Problems of Compatibility Testing	3
87.816	Principles of Hematology and Coagulation Related to Transfusion	3
87.822	Medical Laboratory Management II	2
87.828	Health Science Education III	2
87.833	Immunobiology	2
87.843	Immunobiology Laboratory	2
87.990	Graduate Research Report I	2
87.991	Graduate Research Report II	2-4
90.823	Biochemistry III	2

39.9H1	Economics of Medical Care and Health Manpower	3
39.9H3	Economics of Education	3
50.815	Research Design in Education	2
50.817	Research Problems in Education	2
71.852	Health Care Administration I	2
71.853	Health Care Administration II	2
71.855	Human Relations	2
72.834	Clinical Chemistry I	2
72.835	Clinical Chemistry II	2
72.863	Anti-infectives	2
72.864	Cancer Therapy and Carcinogenesis	2
73.816	Concepts in Toxicology I	2
73.817	Concepts in Toxicology II	2
73.818	Special Topics in Pharmacology	2
73.844	Drug Metabolism	2
87.803	Medical Immunology and Serology	2
87.804	Medical Parasitology	2
87.810	Functions of the Human Systems	2
87.813	Genetic and Immunological Aspects of Blood Group Identification	2
87.814	Principles and Foundations of the Blood Group Systems	3
87.815	The Design and Problems of Compatibility Testing	2
87.816	Principles of Hematology and Coagulation Related to Transfusion	3
87.817	Immunohematology Administration	4
87.818	Transfusion Therapy	4
87.822	Medical Laboratory Management II	2
87.823	Immunohematology	2
87.827	Health Science Education II	2
87.828	Health Science Education III	2
87.842	Hematology II	2
87.843	Immunobiology Laboratory	2
87.852	Hematology III	2
87.991	Graduate Research Report II	2-4
87.992	MLS Thesis	6
90.823	Biochemistry III	2

## **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN MEDICINAL CHEMISTRY**

### **Objectives**

The primary goal of this program is the education of professionals interested in the following areas: the rational development, isolation, and analysis of drugs; the understanding of the chemical mechanisms by which these compounds function in mammalian systems; and the metabolism of such biologically active agents. For this purpose the program is composed of four distinct areas of study: medicinal chemistry, pharmacology and toxicology, biochemistry, and organic chemistry. This type of background gives preparation to an individual interested in using chemistry for biological and clinical purposes. The medical research team needs scientists with this training and orientation.

### **Admission and Program Features**

Application for admission to this program is welcomed from any individual who has obtained a baccalaureate degree in pharmacy, chemistry, biology, and related programs within the biological or physical sciences from a recognized institution. Further, his undergraduate record must indicate a high level of previous work and sufficient background in organic chemistry, mathematics, and biology. Applicants with deficiencies in these areas may be admitted as Special Students. Students admitted with deficiencies must remove them during the first 12 quarter hours of graduate work.

The program is available on a part-time basis, with courses offered primarily during the evening hours. Courses are scheduled in the fall, winter, spring, and summer quarters. It is anticipated that students may complete the degree requirement in a minimum of three years; however, in some cases the duration may be increased or decreased to satisfy the particular needs and requirements of the student. No research report or thesis is required.

The Graduate School recognizes the divergent backgrounds and goals of individuals who may be accepted into this program. Accordingly, the program is designed to offer flexibility in course selection so as to maximize its relevance to the student's career objective.

### **General Requirements**

A candidate must complete a minimum of 40 quarter hours of graduate work. A total of 24 required credits must be taken: 10 quarter hours of medicinal chemistry courses, six quarter hours of pharmacology and toxicology, four quarter hours of biochemistry and related areas, and four quarter hours of organic chemistry. The balance of 40 hours may be taken from an elective list.

An individual who has deficiencies in any of the areas required for admission may take appropriate courses at Northeastern University concurrently with those graduate courses which do not require the deficient prereq-

uisites. The appropriate evening courses offered at University College of Northeastern University are: Analytical Chemistry 12.521-12.526; Organic Chemistry 12.531 - 12.533; Physical Chemistry 12.541-12.543; and Human Anatomy and Physiology 18.524-18.526. Equivalent courses from this University or other accredited universities will be accepted.

### Curriculum

<i>Required Courses</i>		<i>Minimum Credits</i>
1. Medicinal Chemistry from the following courses:	8 quarter hours	
72.861 CNS Depressants		2
72.862 Autonomic Drugs		2
72.863 Anti-infectives		2
72.864 Cancer Therapy and Carcinogenesis		2
72.865 Special Topics in Medicinal Chemistry		2
72.866 Phytochemistry		2
2. Pharmacology and Toxicology from the following courses:	6 quarter hours	
73.814 Concepts in Pharmacology I		2
73.815 Concepts in Pharmacology II		2
73.816 Concepts in Toxicology I		2
73.817 Concepts in Toxicology II		2
73.818 Special Topics in Pharmacology		2
3. Biochemistry, Clinical Chemistry, and Drug Metabolism from the following courses:	4 quarter hours	
72.834 Clinical Chemistry I		2
72.835 Clinical Chemistry II		2
73.844 Drug Metabolism		2
90.821 Biochemistry I		2
90.822 Biochemistry II		2
90.823 Biochemistry III		2
4. Organic Chemistry from the following courses:	4 quarter hours	
12.861 Advanced Organic Chemistry I		2
12.862 Advanced Organic Chemistry II		2
12.863 Physical Organic Chemistry		2
12.864 Stereochemistry I		2
12.865 Stereochemistry II		2
12.866 Spectrometric Identification of Organic Compounds		2
12.876 Mechanisms of Organic Reactions I		2
12.877 Mechanisms of Organic Reactions II		2
5. 72.867 Medicinal Chemistry Seminar	2 quarter hours	
TOTAL CREDITS		24

*Continued on page 54*

# SAMPLE PROGRAM

## MASTER OF SCIENCE IN MEDICINAL CHEMISTRY

### YEAR 1

<i>Fall Quarter</i>		<i>Winter Quarter</i>		<i>Spring Quarter</i>	
12.861	Advanced Organic Chemistry I	2	12.862	Advanced Organic Chemistry II	2
72.863	Anti-infectives	2	72.862	Autonomic Drugs	2

<i>Summer Quarter</i>	
72.867	Medicinal Chemistry Seminar

### YEAR 2

<i>Fall Quarter</i>		<i>Winter Quarter</i>		<i>Spring Quarter</i>	
72.866	Phytochemistry	2	72.865	Special Topics in Medicinal Chemistry	2
73.814	Concepts in Pharmacology I	2	73.815	Concepts in Pharmacology II	2
90.821	Biochemistry I	2	90.822	Biochemistry II	2

### YEAR 3

<i>Fall Quarter</i>		<i>Winter Quarter</i>		<i>Spring Quarter</i>	
	Elective	2	73.816	Concepts in Toxicology I	2
			73.844	Drug Metabolism	2

### ELECTIVES

<i>Fall Quarter</i>		<i>Winter Quarter</i>		<i>Spring Quarter</i>	
12.821	Analytical Separations	2	18.835	Mammalian Physiology	4
12.827	Computers in Chemistry	2	18.860	Cell Biophysics and Biochemistry	5
18.842	Vertebrate Endocrinology	2	72.812	Advanced Drug Synthesis	3
18.909	Animal Virology	4			
87.807	Biometrics	2			
<i>Summer Quarter</i>					
72.865	Special Topics in Medicinal Chemistry	2			
90.824	Applications of Mass Spectrometry	2			

**Elective Courses**

Taken with the approval of the Director of the M.S. program in Medicinal Chemistry. Selection may be made from the above courses or other appropriate graduate courses in the Graduate School of Pharmacy and Allied Health Professions or in the University.

	16 quarter hours	
12.821	Analytical Separations	2
12.823	Optical Methods of Analysis	2
12.827	Computers in Chemistry	2
12.846	Coordination Chemistry	2
18.242	Medical Microbiology	4
18.835	Mammalian Physiology	4
18.840	Comparative Physiology of Regulatory Mechanisms	2
18.842	Vertebrate Endocrinology	2
18.843	Procedures in Endocrinology	3
18.860	Cell Biophysics and Biochemistry	5
18.905	Marine Microbiology	4
18.909	Animal Virology	4
18.940	Microbial Biochemistry	2
72.812	Advanced Drug Synthesis	3
72.836	Special Topics in Clinical Chemistry	2
73.845	Radioisotopes in Biological Systems	2
87.807	Biometrics	2
90.824	Applications of Mass Spectrometry	2

A minimum total of 40 quarter hours is required for completion of the M.S. in Medicinal Chemistry.

### **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN PHARMACOLOGY**

**Objectives**

The pharmacologist is concerned with the discovery, testing, and perfecting of drugs and the study of how they act, especially in mammalian systems. With the increasing concern of pharmaceutical companies, hospitals, and research institutions for knowledge of the mechanisms by which drugs produce their effects, the role of the pharmacologically trained scientist is ever expanding. In the education of such an individual, a broad background in pharmacology, physiology, anatomy, instrumentation, and chemistry is essential. The goal of Northeastern's program is to meet this objective and to prepare individuals to make significant contributions in the many areas requiring pharmacological expertise.

## Admission and Program Features

Application for admission as a graduate student is welcomed from any individual who has obtained a baccalaureate degree in pharmacy, chemistry, biology, or related programs within the biological or physical sciences from a recognized institution. Further, the applicant's undergraduate record must indicate sufficient background in organic chemistry, mathematics, and biology. However, applicants with deficiencies in these areas may be admitted as Special Students. Students admitted with deficiencies must remove them during the first 12 quarter hours of graduate work.

The program is available on a part-time basis, with courses offered primarily during the evening hours. Courses are scheduled in the fall, winter, spring, and summer quarters. It is anticipated that students may complete the degree requirements in a minimum of three years. However, the duration may be longer or shorter, depending upon the particular student. No research report or thesis is required.

The Graduate School recognizes the divergent background and goals of individuals who may be accepted into this program. Accordingly, the program is designed to offer flexibility in course selection so as to maximize its relevance to the student's career objectives.

## General Requirements

A candidate must complete a minimum of 40 quarter hours of graduate work. A total of 24 required credits must be taken: 16 quarter hours within the Pharmacology sequence and eight quarter hours from the Chemistry sequence. The balance of the 40 quarter hours may be selected from graduate courses in the Graduate School of Pharmacy and Allied Health Professions or in other divisions of the University. Selection of the elective courses should be made with the approval of the Director of the M.S. program in Pharmacology.

## Curriculum

1. <i>Required Courses</i>	<i>Credits</i>
73.814 Concepts in Pharmacology I	2
73.815 Concepts in Pharmacology II	2
73.816 Concepts in Toxicology I	2
73.817 Concepts in Toxicology II	2
73.818 Special Topics in Pharmacology	2
* 73.826 Seminar and Report in Pharmacology I	2
73.835 Neuropharmacology	2

Continued on next page

\*The first quarter of 72.826 is a required course; however, the course may be repeated twice as an elective (73.827 Seminar and Report in Pharmacology II and 73.828 Seminar and Report in Pharmacology III).

73.844	Drug Metabolism	2
87.807	Biometrics	2
87.810	Functions of the Human Systems (or equivalent)	2
90.821	Biochemistry I	2
90.822	Biochemistry II	2
		<hr/>
		24 Q.H.

## 2. *Elective Courses*

18.835	Mammalian Physiology	4
18.840	Comparative Physiology of Regulatory Mechanisms	4
18.842	Vertebrate Endocrinology	2
18.843	Procedures in Endocrinology	3
18.909	Animal Virology	4
72.834	Clinical Chemistry I	2
72.835	Clinical Chemistry II	2
72.861	CNS Depressants	2
72.862	Autonomic Drugs	2
72.863	Anti-infectives	2
72.864	Cancer Therapy and Carcinogenesis	2
73.829	Experimental Pharmacology	3
73.845	Radioisotopes in Biological Systems	2
** 73.903	Thesis Preparation	2
87.811	Pathophysiology I	2
87.812	Pathophysiology II	2
87.833	Immunobiology	2
87.843	Immunobiology Laboratory	2
90.823	Biochemistry III	2
90.824	Applications of Mass Spectrometry	2

Additional electives may be selected from other appropriate graduate courses in the University with the approval of the Director of the M.S. program in Pharmacology and the course instructor.

\*\*In certain circumstances an M.S. Thesis option may be elected by a student with the approval of the Director of the M.S. program in Pharmacology. Under this option, a student is required to develop, write and defend a research thesis in addition to the satisfactory completion of 32 quarter hours of graduate course work. The research may be carried out under appropriate supervision in one of the many research laboratories in the Boston area.



# SAMPLE PROGRAM

## MASTER OF SCIENCE IN PHARMACOLOGY

<b>Fall Quarter</b>		<b>YEAR I</b>		<b>Spring Quarter</b>	
73.814	Concepts of Pharmacology I	2		2	Neuropharmacology
87.810	Functions of the Human Systems	2		2	Elective
<b>Fall Quarter</b>		<b>YEAR II</b>		<b>Spring Quarter</b>	
	Elective	2		2	Seminar & Report in Pharmacology
90.821	Biochemistry I	2		2	Concepts in Toxicology II
<b>Fall Quarter</b>		<b>YEAR III</b>		<b>Spring Quarter</b>	
	Elective	2		2	Experimental Pharmacology
87.807	Biometrics	2		2	Elective
	Elective	2		2	Elective
<b>Summer Quarter</b>		<b>ELECTIVES</b>		<b>Spring Quarter</b>	
72.865	Special Topics in Medicinal Chemistry	2		4	Comp. Phys. of Reg. Mech.
90.824	Applications of Mass Spectrometry	2		2	Procedures in Endocrinology
<b>Fall Quarter</b>		<b>Winter Quarter</b>		2	CNS Depressants
18.842	Vertebrate Endocrinology	2		2	Cancer Therapy & Carcinogenesis
18.909	Animal Virology	4		2	Experimental Pharmacology
72.834	Clinical Chemistry I	2		2	Radioisotopes in Biolog. Systems
72.863	Anti-infectives	2		2	Pathophysiology II
<b>Summer Quarter</b>		<b>Winter Quarter</b>		2	Immunobiology
72.865	Special Topics in Medicinal Chemistry	2		2	Immunobiology Lab
		2		2	Biochemistry III

## **PART-TIME MASTER OF SCIENCE DEGREE PROGRAM IN RADIOPHARMACEUTICAL SCIENCE**

### **Objectives**

During the last decade many new experimental tools and methods have been placed in the hands of professionals and practitioners in the allied health professions. These have been used to probe more widely and more deeply into the nature of man's clinical problems. Of all the new techniques, none has been employed in more diverse means nor yielded greater rewards than the use of radioactive isotopes for both diagnostic and therapeutic procedures.

There is a critical need for individuals with background and training in the area of radiopharmaceuticals and radiochemicals. They will be employed in the pharmaceuticals industry, in hospitals, and in various clinical and chemical laboratories. The function of this program is to supply the in-depth knowledge necessary for the education of such professionals.

### **Admission and Program Features**

Applicants for this program must have completed a baccalaureate program in pharmacy, biology, chemistry, medical technology, physics or a related field. Undergraduate requirements are: a minimum of two quarters of organic chemistry, one quarter of analytical chemistry or its equivalent, two quarters of human physiology, and one quarter of physics. An individual who has deficiencies in any of these areas may take appropriate courses at Northeastern University or at any other recognized institution concurrently with those graduate courses which do not require the deficient prerequisites. Students admitted with deficiencies must remove them during the first 12 quarter hours of graduate work.

The program is available on a part-time basis, with courses offered primarily during the evening hours. Courses are scheduled in the fall, winter, spring, and summer quarters. It is anticipated that students may complete the degree requirements in a minimum of three years; however, in some cases the duration may be increased or decreased to satisfy the particular needs and requirements of the student. No research or thesis is required but a research elective is available.

The Graduate Committee recognizes the divergent backgrounds and goals of individuals who may be accepted into this program. Accordingly, the program is designed to offer flexibility in course selection so as to maximize its relevance to the student's career objectives. Each student is assigned a faculty advisor who assists him in course selection and apprises him of those offerings which will strengthen his background in the areas of his interest. In essence, this advisor functions in tailor making the program for the student's individual needs.

# Curriculum

<i>Required Courses</i>		<i>Credits</i>
11.871	Radiation Physics	2
11.872	Radiobiology	2
72.815	Nuclear Medicine I: Instrumentation	2
72.816	Nuclear Medicine II: Instrumentation	2
72.817	Nuclear Medicine III: Radiopharmaceuticals	2
72.818	Nuclear Medicine IV: Radiopharmaceutical Laboratory	2
72.844	Seminar and Research Report in Radiopharmaceutical Science	2
72.847	Dosimetry and Health Physics	2
72.848	Clinical Aspects of Nuclear Medicine	2
72.849	Radiopharmacy Internship	2
87.807	Biometrics	2
90.821	Biochemistry I	2
	QUARTER HOURS	24

## *Elective Core*

A minimum of 10 credits must be taken from the following list:

72.834	Clinical Chemistry I	2
72.835	Clinical Chemistry II	2
72.863	Anti-infectives	2
72.864	Cancer Therapy and Carcinogenesis	2
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.816	Concepts in Toxicology I	2
73.817	Concept in Toxicology II	2
73.844	Drug Metabolism	2
87.810	Functions of the Human Systems	2
87.811	Pathophysiology I	2
87.812	Pathophysiology II	2
90.822	Biochemistry II	2
90.823	Biochemistry III	2

## *Additional Electives*

These are to be taken with the approval of a faculty advisor in the Department of Medicinal Chemistry and Pharmacology in the Graduate School of Pharmacy and Allied Health Professions and the course instructor. Selection may be made from the above courses, as well as from the following and from other appropriate graduate courses in the University. Course availability is subject to change.

12.841	Inorganic Chemistry I	2
12.842	Inorganic Chemistry II	2
12.846	Coordination Chemistry	2



12.861	Advanced Organic Chemistry I	2
12.862	Advanced Organic Chemistry II	2
12.866	Spectrometric Identification of Compounds	2
18.245	Serology-Immunology	3
18.835	Mammalian Physiology	4
18.840	Comparative Physiology of Regulatory Mechanisms	2
18.842	Vertebrate Endocrinology	2
18.843	Procedures in Endocrinology	3
18.860	Cell Biophysics and Biochemistry I	5
18.861	Cell Biophysics and Biochemistry II	5
72.865	Special Topics in Medicinal Chemistry	2
73.818	Special Topics in Pharmacology	2
73.819	Pharmacological Instrumentation	2
73.822	Pathology	2
87.805	Advanced MLS-Chemistry and Instrumentation	4
87.833	Immunobiology	2
87.843	Immunobiology Laboratory	2

A minimum total of 40 quarter hours of graduate credit is necessary for completion of the Master of Science degree in Radiopharmaceutical Science.

## FULL-TIME DOCTOR OF PHILOSOPHY DEGREE PROGRAM IN MEDICINAL CHEMISTRY

### Objectives

The purpose of this program is to educate the research scientist interested in applying chemistry to the solution of biological and medical problems. Such research may take the form of synthesizing new drugs — both radioactive and nonradioactive — for diagnosis and a variety of disease conditions, determining metabolic products derived from compounds of an endogenous or exogenous origin, elucidating various biochemical pathways, developing and utilizing analytical methodologies for drugs and various biochemical compounds, and isolating drugs from natural sources. These are a few of the types of research projects which are available within the Department of Medicinal Chemistry and Pharmacology.

In addition to the student's demonstration of superior proficiency in original research, he must acquire the background knowledge via courses and outside reading in the current scientific literature in his area of specialization to complete the qualifying examination satisfactorily. For this purpose, a working knowledge of at least one foreign language is required. Any student who wishes to pursue the doctorate must write directly to the Director of the Ph.D. program.

**Admission and Program Features**

Application for admission is welcomed from any individual who has obtained a baccalaureate degree in pharmacy, chemistry, biology, medical laboratory science, and related programs within the biological or physical sciences from a recognized accredited institution. Further, the undergraduate record must indicate a very high level of previous work and sufficient background in organic chemistry, mathematics, and biology. Deficiencies in these areas must be removed within the first academic year. Admission to this program is by acceptance of the Graduate Committee. A student is considered to be in the doctoral program after being accepted, but not before taking up full-time residence.

**Course Requirements**

There are no specific course requirements beyond those which may be required for a master's degree, but in order for a student to be completely prepared for both the research program and the qualifying examination, an appropriate course background is desirable.

**INTERDISCIPLINARY PH.D. PROGRAM IN FORENSIC CHEMISTRY**

This program is being offered in conjunction with the Colleges of Criminal Justice and Northeastern University's Institute of Chemical Analysis, Applications and Forensic Science. This unique program in an area of societal need is designed as a preparation for research and leadership positions in forensic laboratories. The Graduate School of Pharmacy and Allied Health Professions is the registering department for specialization in forensic toxicology. Two other specializations, namely forensic analytical chemistry and forensic materials science are administered by the Chemistry Department in conjunction with the College of Criminal Justice. Admission is made through the registering department.

For students entering with a B.S., completion of the M.S. course requirements in Forensic Chemistry with a B average is required to qualify for further Ph.D. study. For students with M.S. degrees in forensic science or the natural sciences, individual programs are planned according to the student's background. The course of study includes comprehensive examinations, thesis research to be carried out at the Institute of Chemical Analysis, Applications and Forensic Science and a recommended internship at a major forensic laboratory engaged in research.

# **courses**

## **DESCRIPTION OF COURSES**

**5.800 See Graduate School of Engineering Catalog**

**11.871 Radiation Physics (2 q.h.)**

An introduction to the nucleus and modes of spontaneous radioactive transformation. The isotopic abundance of the elements, naturally occurring radioelements and decay series, the kinetics of decay and the relationship between mass and energy. The nature of the emitted radiation and its interaction with matter. *Prep. Undergraduate physics.*

Yearly, Fall Quarter

**11.872 Radiobiology (2 q.h.)**

The biological effects of ionizing radiation. Included is a discussion of elementary target theory, radiation chemistry, effects on macromolecules, cellular and chromosomal effects, recovery processes, and the acute and long-term effects of radiation with emphasis on man, as well as a discussion of environmental sources of radiation and the characteristics of internal and external human exposure. *Prep. 11.871.*

Yearly, Winter Quarter

**12.253 Identification of Organic Compounds (3 q.h.)**

Qualitative analysis of organic compounds and mixtures, using physical, chemical, and instrumental methods. *Prep. 12.155.*

Yearly, Spring and Summer Quarters

**12.500 See University College Catalog**

**12.821 Analytical Separations (2 q.h.)**

Theory and practice of analytical separation techniques. Emphasis on fundamentals as they relate to practice. Topics based mainly on chromatographic processes, including gas and high-speed liquid chromatography. Other topics include: zone refining, liquid extraction, and electrophoresis.

Yearly, Fall Quarter

**12.822 Electroanalytical Chemistry (2 q.h.)**

The principles and practice of electroanalytical chemistry. Topics include: potentiometry and ion-selective electrodes, normal and thin-layer coulometry, polarography, and electrochemical relaxation methods. Application of these techniques to titration endpoint detection.

Yearly, Winter Quarter

**12.823 Optical Methods of Analysis (2 q.h.)**

The theory and practice of absorption and emission spectroscopy. Instruments, methods, and applications are considered.

Yearly, Spring Quarter

**12.824, 12.825, 12.826 Special Topics in Analytical Chemistry I, II, III (2 q.h.)**

Selected topics of current importance in analytical chemistry.

Yearly, Fall, Winter, and Spring Quarters

**12.827 Computers In Chemistry (2 q.h.)**

A laboratory-lecture course illustrating the use of small digital computers for real-time control of chemical instruments. Topics include: digital logic, real-time data structures, A/D and D/A conversion, noise, and other aspects of real-time computer interfacing. Programming done on a PDP-11 computer in MIRACL, a language designed for real-time processing. *Prep. consent of instructor.*

Yearly, Fall Quarter

**12.828 Chemical Instrumentation (2 q.h.)**

Principles of instrument design considered, with emphasis on practical aspects. Instrument limitations and sources of error studied, along with modular instruments and interfacing. *Prep. consent of instructor.*

Yearly, Winter Quarter

**12.861, 12.862 Advanced Organic Chemistry I, II (2 q.h.)**

An intensive survey of organic reactions. Modern concepts of structure and mechanism are used to correlate factual material. *Prep. one year of Organic Chemistry.*

Yearly, Fall and Winter Quarters

**12.863 Physical Organic Chemistry (2 q.h.)**

Application of LCAO concepts, linear free energy relationships, interactions between solvent effects, steric considerations, and electronic factors, and introduction to orbital symmetry direction of concerted reactions. *Prep. 12.862 or consent of instructor.*

Yearly, Spring Quarter

**12.864, 12.865 Stereochemistry I, II (2 q.h.)**

Interrelation of steric arrangements of atoms in organic molecules with their physical and chemical properties. Conformational analysis. Spatial relationships between atoms and groups during chemical reactions and consequent effects on chemical equilibria and reaction rates as an introduction to the study of reaction mechanisms. *Prep. 12.863.*

Yearly, Fall and Winter Quarters

**12.866 Spectrometric Identification of Organic Compounds (2 q.h.)**

Interpretation of the ultraviolet, infrared, nuclear magnetic resonance and mass spectra of organic compounds. *Prep. one year of Organic Chemistry.*

Yearly, Spring Quarter



**12.876, 12.877 Mechanisms of Organic Reactions I, II (2 q.h.)**

Consideration of the fundamental factors influencing the course of a chemical reaction. Study of the effects of structural and environmental changes on the mechanisms of organic reactions. *Prep.* 12.865.

Yearly, Winter and Spring Quarters

**12.800 See Graduate School of Arts and Sciences Catalog**

**18.200 See Undergraduate Catalog**

**18.240 Microbial Physiology (4 q.h.)**

The biochemical changes brought about through microbial activities; measurement of metabolic biosynthesis and degradation, rates of reaction and determination of end products. *Prep.* 18.220.

Yearly, Fall and Winter Quarters

**18.800 See Graduate School of Arts and Sciences Catalog**

**19.800 See Graduate School of Arts and Sciences Catalog**

**21.800 See Graduate School of Arts and Sciences Catalog**

**39.900 See Graduate School of Arts and Sciences Catalog**

**41.800 See Graduate School of Business Administration Catalog**

**45.800 See Graduate School of Business Administration Catalog**

**50.800 See Graduate School of Education Catalog**

**71.815 Biopharmaceutics and Pharmacokinetics (2 q.h.)**

Treatment of the factors affecting drug availability from various dosage forms. Included is the influence of the route of administration and the dosage regimen on drug availability. Additionally, a quantitative treatment of dynamics of drug absorption, distribution, metabolism, and excretion, as well as the development of mathematical models for those processes, is considered. *Prep.* admission to hospital pharmacy program.

Yearly, Fall Quarter

**71.816 Clinical Pharmacokinetics (2 q.h.)**

Emphasis is placed upon application of various pharmacokinetic techniques in estimating dosage regimens, evaluating drug therapy, consulting on drug selection and assessment of bioavailability and bioequivalence data.

*Prep.* 71.815 or equivalent.

Yearly, Spring Quarter

**71.822 Project Seminar and Report in Hospital Pharmacy (2 q.h.)**

Seminar on current developments or specific problems in hospital phar-

macy which have been studied in depth by students with guidance from the graduate faculty. The student presentations may be alternated with guest speakers on topics of current interest. Student participation in the discussions is an essential objective of the course. *Prep. admission to hospital pharmacy program.* Yearly, Summer Quarter

**71.823 Legal Aspects/Federal Legislation In Pharmacy (2 q.h.)**

An analysis of the Federal and state laws relating to the distribution of drugs in the institution. Included are common law liabilities such as malpractice and other frequently encountered problems. *Prep. admission to hospital pharmacy program.* Yearly, Fall Quarter

**71.844 Hospital Pharmacy Administration I (2 q.h.)**

Administration of the pharmacy department in an institutional environment. Study of budgets, purchasing, and distribution procedures. Medium-scale production of preparations for dispensing. Personnel management, public relations, legal responsibilities, educational demands, professional communications, and general administrative function of a hospital pharmacist. *Prep. admission to hospital pharmacy program or consent of instructor.*

Alternate Years, Fall Quarter

**71.845 Hospital Pharmacy Administration II (2 q.h.)**

A continuation of 71.844 Hospital Pharmacy Administration I. *Prep. 71.844.*

Alternate Years, Winter Quarter

**71.846 Hospital Pharmacy Administration III (2 q.h.)**

A continuation of 71.845 Hospital Pharmacy Administration II. *Prep. 71.845.*

Alternate Years, Spring Quarter

**71.852 Health Care Administration I (2 q.h.)**

The socio-economics and statistics of health care, including governmental programs, legislative trends, third-party insurance and welfare programs, and other areas that may affect the management of the modern institutional pharmacy. *Prep. admission to the hospital pharmacy program or consent of instructor.*

Alternate Years, Fall Quarter

**71.853 Health Care Administration II (2 q.h.)**

A continuation of 71.852 Health Care Administration I. *Prep. 71.852.*

Alternate Years, Winter Quarter

**71.854 Clinical Pharmacy (2 q.h.)**

The patient-oriented aspects of the application of therapeutic agents to hospital patients. An in-depth study of the relation of therapeutic regimens to laboratory tests and drug interactions. The role of the hospital pharmacist as an active member of the actual health-care team dealing directly with in-patients and out-patients. *Prep. admission to hospital pharmacy program or consent of instructor.*

Alternate Years, Fall Quarter

**71.855 Human Relations (2 q.h.)**

A study of personnel psychology, organization structuring, wage and performance incentives, employee evaluations, and policy in relation to accepted personnel concepts and procedures. *Prep. admission to hospital pharmacy program or consent of instructor.*

Alternate Years, Spring Quarter

**71.856 Information Science In Hospital Pharmacy (2 q.h.)**

The terminology and operation of data processing systems, including hardware and software, is presented. An extensive review of past, present and future applications of data processing systems to institutional pharmacy practice is a major focus of this course. Systems design, evaluation and proposal development to administrators is discussed. *Prep. Admission to Hospital Pharmacy Program or Consent of Instructor.*

Yearly, Winter Quarter

**71.858 Contemporary Therapeutics I (2q.h.)**

Recent developments in current therapeutic approaches and their rationale in the treatment of cardiovascular, neurological, gastrointestinal, musculoskeletal, and metabolic diseases of a noninfectious nature. Therapy related to aging and selected genetic diseases. *Prep. 71.854.*

Alternate Years, Winter Quarter

**71.859 Contemporary Therapeutics II (2 q.h.)**

Current concepts of infectious diseases and the rationale for the chemotherapeutic treatment of these conditions. Diseases of the blood and blood-forming organs, neoplastic disease, and diseases related to deficiency states. *Prep. 71.854.*

Alternate Years, Spring Quarter

**71.860 Drug Monitoring (2 q.h.)**

The process by which drugs are monitored to determine their effectiveness, safety, prevention of iatrogenic factors, drug-drug interactions, and matters affecting patient compliance with a therapeutic regimen. The utilization of this information in improving patient care. *Prep. 71.854.*

Alternate Years, Fall Quarter

**71.861 Sterile Products (2 q.h.)**

Theory, principles, methods, and techniques in preparing sterile, pyrogen- and particulate-free products. Equipment and laboratory design required for manufacturing different types of sterile products and the practical considerations essential for their production. *Prep. Microbiology.*

Yearly, All Quarters

**71.862 Hospital Preparations (2 q.h.)**

Therapeutic concepts, pharmaceutical problems, and methods of preparing various specialized clinical preparations and mixtures. These include: hyperalimentation solutions, dialysis solutions, cationic or anionic adjust-

ment solutions, irrigation solutions, pediatric preparations, reconstitution preparations, additive admixtures, and unit dose packaging. *Prep. admission to hospital pharmacy program.* Alternate Years, Spring Quarter

**72.812 Advanced Drug Synthesis (3 q.h.)**

Application of synthetic and analytical techniques to the formation of new drugs. *Prep. two quarters of Organic Chemistry with laboratory.*

Alternate Years, Winter Quarter

**72.815 Nuclear Medicine I: Instrumentation (2 q.h.)**

An introduction to nuclear detection techniques by both lecture and laboratory demonstration. All types of systems will be considered, including scintillation, ionization, gas and solid state detectors. Basic principles of spectrometry with an emphasis on sodium iodide detectors will be studied.

*Prep. 11.871.*

Yearly, Winter Quarter

**72.816 Nuclear Medicine II: Instrumentation (2 q.h.)**

A study of the application of nuclear detection techniques in the physical aspects of nuclear medicine. Current clinical instrumentation including gamma cameras and scanners, probes and whole body counters, as well as future developments such as the solid state and the multiwire proportional cameras, and positron and tomographic imaging devices. Principles of collimation are studied with each system. The application of computers in nuclear medicine. This course includes both lecture and laboratory demonstration and is a companion course to 72.815. *Prep. 11.871 and 72.815.*

Yearly, Spring Quarter

**72.817 Nuclear Medicine III: Radiopharmaceuticals (2 q.h.)**

A study of the chemical and biological aspects of nuclear medicine. A discussion of the methods of radiopharmaceutical preparation and quality control, the use of the agent in organ imaging and as disease specific radiotracers. As well as *in vivo* nuclear medicine, *in vitro* tests will be considered, including radioimmunoassay and competitive binding assays. The therapeutic use of radioactive compounds will also be studied. *Prep. 72.815 and 72.816.*

Yearly, Winter Quarter

**72.818 Nuclear Medicine IV: Radiopharmaceutical Laboratory (2 q.h.)**

Demonstrations and discussions of the preparation and quality control of radiopharmaceuticals derived from reactor, accelerator and generator produced radionuclides. Assay techniques for radiochemical, radionuclide and chemical purity. Regulatory implications in the handling and dispensing of radioactive drugs. This is a companion course to 72.817. *Prep. 72.817.*

Yearly, Spring Quarter

**72.834 Clinical Chemistry I (2 q.h.)**

Principles, instrumentation methodologies, and interpretations in clinical chemistry. *Prep. 90.823.*

Yearly, Fall Quarter

**72.835 Clinical Chemistry II (2 q.h.)**

A continuation of Clinical Chemistry I. *Prep.* 72.834. Yearly, Winter Quarter

**72.836 Protein Analysis (2 q.h.)**

Laboratory (preparations, analyses, interpretations), lecture, and discussion (current journal articles) of electrophoretic and immunochemical methods of analysis for proteins of clinical and forensic interest. *Prep.* 72.835. Yearly, Spring Quarter

**72.837, 72.838, 72.839 Seminar and Report in Clinical Chemistry I, II, III (2-6 q.h.)**

Reports and discussions of current journal articles in clinical chemistry. *Prep.* 72.835. Yearly, Winter Quarter

**72.844 Seminar and Research Report in Radiopharmaceutical Science (2 q.h.)**

This course is designed to familiarize the student with literature sources and the latest developments in radiopharmaceutical science. A written and oral presentation will be required in a particular area as evidence of an ability to organize and evaluate published material. *Prep.* 72.816.

Yearly, Winter Quarter

**72.847 Dosimetry and Health Physics (2 q.h.)**

Review of radiation units and measures of dose. Emphasis will be on the calculation of absorbed dose to the human body from gamma and beta emitters using MIRD pamphlets. Also discussed will be the health physics aspects of nuclear medicine including radiation protection, shielding design and instrumentation. *Prep.* 72.816.

Yearly, Fall Quarter

**72.848 Clinical Aspects of Nuclear Medicine (2 q.h.)**

The current practice of diagnostic nuclear medicine in both large medical centers and small community hospitals will be discussed. The effect of pathology in the distribution of radiopharmaceuticals will be considered on an organ and disease basis and illustrated with actual patient findings. The techniques employed in imaging the various organs and body compartments will be presented. Factors influencing the decision to perform a diagnostic nuclear medicine procedure and the choice of the agent to be employed will be discussed. *Prep.* 72.818.

Yearly, Spring Quarter

**72.849 Radiopharmacy Internship (2 q.h.)**

This is designed as a practical on-site introduction to the use of radiopharmaceuticals in the clinical environment. The student will participate in all normal functions of a radiopharmacy. Operations such as ordering, preparation, dispensing and distribution of radiodiagnostics, manufacture of non-routine agents and quality control procedures and record keeping.

This is considered a laboratory course. Arrangements will be made on an individual basis and the site of the radiopharmacy will be by approval of the instructor. Offered in all quarters, registration will take place during the Spring quarter only. *Prep. 72.818.* Yearly, All Quarters

**72.850 Medicinal Chemistry Colloquium (2 q.h.)**

Oral presentations by the participants on current research in medicinal chemistry and related areas in pharmacy. Included will be the theoretical basis of the problem as well as experimental results obtained. *Prep. Ph.D. Candidate.* Yearly, All Quarters

**72.861 CNS Depressants (2 q.h.)**

Presentation and discussion of the chemistry, structure-activity relationships, and mechanism of action of general anesthetics, hypnotics and sedatives, antiepileptics, analgetics, tranquilizers, and muscle relaxants. A consideration of the mechanics of drug design and methods of modification is undertaken. *Prep. two quarters of Organic Chemistry.*

Alternate Years, Spring Quarter

**72.862 Autonomic Drugs (2 q.h.)**

A discussion of drugs acting on the central nervous system, with special emphasis on the action mechanism of the chemical mediators of the peripheral nervous system. The role of the agents affecting this system — adrenergic and cholinergic and reversible and irreversible inhibitors of these systems — is discussed in relation to their chemical structure and biological activity. *Prep. two quarters of Organic Chemistry.*

Alternate Years, Winter Quarter

**72.863 Anti-Infectives (2 q.h.)**

A study of the various chemotherapeutic agents employed in the treatment of infectious diseases. Included are: the sulfonamides, antibiotics, antivirals; antitubercular, antifungal, and antimalarial agents. Special emphasis is on structure-activity relationships, mechanisms of action, and modern research in each area. *Prep. two quarters of Organic Chemistry.*

Alternate Years, Fall Quarter

**72.864 Cancer Therapy and Carcinogenesis (2 q.h.)**

Recent developments in new approaches to both carcinogenesis and to the treatment of cancer are considered, including alkylating agents, antimetabolites, hormones, miscellaneous compounds, and combinations of the above with radiation and immunology. Possible mechanisms of carcinogenesis and chemotherapeutic action explored. *Prep. two quarters of Organic Chemistry.*

Alternate Years, Spring Quarter

**72.865 Special Topics in Medicinal Chemistry (2 q.h.)**

A consideration of a special area of medicinal chemistry, including either steroids, CNS compounds, pharmacodynamic agents or chemotherapeutics; their chemistry and structure. *Prep. two quarters of Organic Chemistry.* Alternate Years, Summer and Winter Quarters

**72.866 Phytochemistry (2 q.h.)**

The important classes of chemical compounds produced by plants considered from the standpoint of their biogenetic origin, detection, isolation, and characterization. Application of these techniques to research in pharmacy, medicine, economics, botany, taxonomy. Introduction to the literature of plant chemistry. *Prep. two quarters of Organic Chemistry and two quarters of Biology.* Alternate Years, Fall Quarter

**72.867 Medicinal Chemistry Seminar (2 q.h.)**

Selection and discussion of pertinent articles in the very recent medicinal chemistry literature carried out by faculty and students. Background and the basis for this research discussed. *Prep. two quarters of Organic Chemistry.* Yearly, Summer Quarter

**73.814 Concepts in Pharmacology I (2 q.h.)**

In-depth coverage of the fundamental principles of pharmacology. The course will cover pharmacodynamics, including dose-effect relationships and drug-receptor interactions. Pharmacokinetic concepts, including absorption, distribution, and elimination will be presented as well as common pathways of drug metabolism. Other topics to be discussed include pharmacogenetics, drug resistance, tolerance and physical dependence. An overview of experimental and clinical drug evaluation in man will be presented. The course is intended as a necessary prerequisite for succeeding courses in pharmacology and toxicology. *Prep. Admission to a graduate department or approval of the instructor.* Yearly, Fall Quarter

**73.815 Concepts in Pharmacology II (2 q.h.)**

Continuation of Concepts in Pharmacology I. *Prep. 73.814.*

Yearly, Winter Quarter

**73.816 Concepts in Toxicology I (2 q.h.)**

An overview of toxicology describing the elements of method and approach that identify the science. Special emphasis will be placed on the systemic site of action of toxicants. The intent of this part of the course is to provide answers to two questions: 1) What kinds of injury are produced in specific organs or systems by toxic agents? 2) What are the agents that produce these effects? *Prep. 73.814* Yearly, Winter Quarter

**73.817 Concepts in Toxicology II (2 q.h.)**

Continuation of Concepts in Toxicology I. *Prep. 73.816.*

Yearly, Spring Quarter

**73.818 Special Topics In Pharmacology (2 q.h.)**

Concepts and current research activity in a variety of areas, including autonomic, renal, cardiovascular, and endocrine pharmacology; chemotherapy; blood; and pharmacological aspects of immunity and allergy. *Prep. 73.815.* Alternate Years, Spring Quarter

**73.822 Pathology (2 q.h.)**

The student is introduced to the study of the nature of disease, emphasizing the general mechanisms and pathogenesis. Of paramount importance is the effect of disease on the human body. The language of disease is stressed. Basic principles of disease processes and more common special diseases covered extensively. A research paper may be assigned at the discretion of the instructor. *Prep. Anatomy and Physiology.*

Yearly, Spring Quarter

**73.826, 73.827, 73.828 Seminar and Report In Pharmacology I, II, III (2-6 q.h.)**

Reports and discussions of research and current journal literature in the field of pharmacology. *Prep. 73.814* Yearly, Spring Quarter

**73.835 Neuropharmacology (2 q.h.)**

Selective topics in the field of neuropharmacology will be considered to provide insight into the technical aspects of performing neuropharmacological research. Drugs of therapeutic interest as well as drugs of abuse will be emphasized. *Prep. 73.814 Concepts of Pharmacology I*

Alternate Years, Spring Quarter

**73.844 Drug Metabolism (2 q.h.)**

Presentation and detoxification mechanisms relating to drug metabolism and excretion patterns; adaptive factors influencing metabolism. *Prep. 90.821.* Yearly, Winter Quarter

**73.845 Radiolotopes In Biological Systems (2 q.h.)**

Methodology of radioactive nuclides and application of these isotopes to biology and medicine, with special emphasis on their use in clinical analysis. *Prep. consent of instructor.* Yearly, Spring Quarter

**87.801 Advanced Medical Laboratory Science — Pathogenic Microbiology (4 q.h.)**

Methods of identification and differentiation of normal and pathogenic body flora. Sensitivity and the antimicrobial drugs. Students participate in some lectures given in 87.201. Assigned individual work on specialized aspects of pathogenic microbiology. *Prep. 18.220, 87.101, or equivalent.*

Yearly, Spring Quarter



**87.802 Advanced Medical Laboratory Science — Hematology and Immunohematology (4 q.h.)**

Morphology and physiology of blood cells and bone marrow in health and disease. Ultrastructure of the blood cells and platelets. Isoimmunization and sensitization. Students participate in some lectures given in 87.202. Assigned individual work on specialized aspects of hematology and immunohematology. *Prep. 87.101, 87.102, or equivalents.*

Yearly, Fall Quarter

**87.803 Medical Immunology and Serology (2 q.h.)**

Medically applied immunological and serological concepts and procedures. Students may participate in some lectures given in 87.203. Assigned individual work on specialized aspects of medical immunology and serology. *Prep. MLS General Microbiology: Basic MLS, Immunology.*

Yearly, Winter Quarter

**87.804 Medical Parasitology (2 q.h.)**

Laboratory identification of human parasites and a study of their life cycles. Students may participate in some lectures given in 87.204. Assigned individual work on specialized aspects of medical parasitology. *Prep. General Microbiology and permission of instructor.*

Yearly, Spring Quarter

**87.805 Advanced Medical Laboratory Science — Chemistry and Instrumentation (4 q.h.)**

Clinical chemistry in the assessment of human physiology in health and disease. Students participate in some lectures given in 87.205. Assigned individual work on specialized aspects of clinical chemistry. *Prep. Analytical Chemistry, Organic Chemistry and Basic MLS Chemistry, or equivalent.*

Yearly, Winter Quarter

**87.807 Biometrics (2 q.h.)**

Statistical methods applied to biological samples and analysis of biological research data. (Note: This course is similar to 18.803 previously available through the Biology Department. *Prep. Course in laboratory math and quality control, or equivalent.*

Yearly, Fall and Spring Quarters

**87.810 Functions of the Human Systems (2 q.h.)**

Histology and physiology of respiratory, urogenital, endocrine, nervous, and digestive systems. Lectures supplemented by current research articles and student reports. *Prep. Biology, Chemistry.*

Yearly, Fall Quarter

**87.811 Pathophysiology I (2 q.h.)**

The nature of the disease process and the use of the laboratory in defining the disease mechanisms. *Prep. Organic Chemistry and 87.810 or equivalents.*

Yearly, Winter Quarter

**87.812 Pathophysiology II (2 q.h.)**

The interpretation of laboratory tests in medicine. *Prep. 87.811*

Yearly, Spring Quarter

**87.813 Genetic and Immunological Aspects of Blood Group Identification (2 q.h.)**

This course includes lectures and laboratory experience dealing with immune response, physical chemistry of immunohematological tests, immunological diseases, tests for detection and identification of antibodies and antigens, principles of human genetics, blood group genetics, population and family studies. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.202 or 87.802 and permission of the instructor.*

Yearly, Winter Quarter

**87.814 Principles and Foundations of the Blood Group Systems (4 q.h.)**

This course includes lectures and laboratory experience with the human blood group systems, their antigens and antibodies, genetic inheritance and interactions, frequencies, mutants and alterations by disease states, blood group testing. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.813 and permission of the instructor.*

Yearly, Winter Quarter

**87.815 The Design and Problems of Compatibility Testing (3 q.h.)**

This course includes lectures and laboratory experience with design and purpose of compatibility testing, factors complicating compatibility procedure, techniques employed in compatibility testing, leukocyte, platelet and tissue compatibility, special crossmatch and transfusion procedures. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.813, 87.814 and permission of the instructor.*

Yearly, Spring Quarter.

**87.816 Principles of Hematology and Coagulation Related to Transfusion (3 q.h.)**

This course includes lectures and laboratory experience dealing with hemoglobins, iron metabolism, blood formation, blood volume functions of circulating cells, anemias, leukemias and lymphomas, coagulation theories, factors and disorders. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.202 or 87.802 and permission of the instructor.*

Yearly, Spring Quarter

**87.817 Immunohematology Administration (4 q.h.)**

This course includes lectures and laboratory experience dealing with standards for Blood Banks and Transfusion Services (Federal, State, AABB), requirements for State, FDA and NIH (BOB) licensing, the American Blood Commission, inspection and accreditation, donor procurement, interbank blood exchange, organization of Blood Bank and Transfusion Service, medical legal aspects of transfusion practice, design of physical facilities,

evaluation, selection, and maintenance of equipment, evaluation, and selection of supplies and reagents, preparation, labeling requirements, quality control systems, proficiency testing programs, record keeping, computer principles, utilization of computer facilities, operations of Donor Facilities and Blood Bank Laboratories. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.802 or 87.202 and permission of the instructor.* Yearly, Fall Quarter

**87.818 Transfusion Therapy (4 q.h.)**

This course includes lectures and laboratory experience dealing with selection of blood donors, phlebotomy and pheresis procedures, processing requirements, donor reactions, blood components, physical characteristics of stored blood, indications for transfusion, transfusion reaction, therapeutic phlebotomy and pheresis, autologous transfusions, pediatric transfusions, massive blood replacement, extracorporeal perfusion, cardiopulmonary bypass, dialysis. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep. 87.202 or 87.802 and permission of the instructor.* Yearly, Fall Quarter

**87.821 Medical Laboratory Management (2 q.h.)**

Management principles, including supervision, communication, laboratory staffing, personnel management, staff evaluation and education. Professional ethics, relationships, and legal responsibilities. Individual research included. *Prep. 87.811, 87.812, 87.815 and consent of instructor.* Yearly, Winter Quarter

**87.822 Medical Laboratory Management II (2 q.h.)**

Laboratory operational principles, including laboratory safety, use of quality control and automated evaluation systems, laboratory economics, administration, and purchasing. Individual research included. *Prep. 87.821* Spring Quarter

**87.826 Health Science Education I (2 q.h.)**

An overview of various aspects of education in the health related professions to include: Design and use of behavioral objectives, evaluation tools (both clinical and didactic), and a survey of various teaching methods. Current journal literature will supplement lecture material. *Prep. Health Professions Major.* Yearly, Fall Quarter

**87.827 Health Science Education II (2 q.h.)**

Various types of learning packages or self instructional aids are examined. With the aid of lecture material and independent assignment, each student will design and produce a fifteen minute auto-tutorial and will present it to the class for critique. Current journal literature will also be used. *Prep. 87.826.* Yearly, Winter Quarter

**87.828 Health Science Education III (2 q.h.)**

Application of learning theory to health science education in teaching didactic and psychomotor skills. Each student will be responsible for presenting one 15 minute unit to the class and an actual class to undergraduate students. Each unit will include defining objectives, selecting evaluation tools, and determining the appropriate instructional technique.

*Prep.* 87.827.

Yearly, Spring Quarter

**87.832 Hematology I—Disorders of the Erythrocytes (2 q.h.)**

The pathophysiology of red cell disorders. Clinical and laboratory correlations of the anemias and polycythemias. *Prep.* *Applied study in hematology.*

Yearly, Fall Quarter

**87.833 Immunobiology (2 q.h.)**

Lectures include topics of current interest in immunobiology, such as organ transplantation, immune tolerance, enhancing and blocking factors, and the immunology of cancer. *Prep.* *consent of instructor.*

Yearly, Spring Quarter

**87.842 Hematology II—Disorders of the Leukocytes (2 q.h.)**

The pathophysiology of white cell disorders. Clinical and laboratory correlations of leukemias, myeloproliferative and lymphoproliferative disorders, infections, and inherited leukocyte anomalies. *Prep.* 87.202 or 87.802; *and applied study in hematology.*

Yearly, Winter Quarter

**87.843 Immunobiology Laboratory (2 q.h.)**

Students are required to undertake individual research projects relating to topics covered in lecture. *Prep.* *consent of instructor.*

Yearly, Spring Quarter

**87.845 Epidemiology (2 q.h.)**

Basic concepts of epidemiology, causes of disease, factors contributed by agents, the human host, and the environment. Acquisition and evaluation of data. Relationship of person, time, and place. Case studies and problems. *Prep.* *Consent of Instructor.*

Yearly, Winter Quarter

**87.852 Hematology III—Coagulation (2 q.h.)**

Clinical and laboratory correlations of coagulation disorders. The use of factor analysis in diagnosis of coagulation disorders. *Prep.* 87.202 or 87.802; 87.812 *and applied study in hematology.*

Yearly, Spring Quarter

**87.858 Cellular Pathology (2 q.h.)**

Control mechanisms, with emphasis on cancer and other cellular abnormalities. *Prep.* 18.227 or *consent of instructor.*

Yearly, Spring Quarter

**87.890 Seminar (1 q.h.)**

Topics to be announced quarterly.

**87.990 Graduate Research Report I (2 q.h.)**

Research of a special topic in medical laboratory science involving individual research is undertaken and reported. Under the direction of a faculty member.

Yearly, All Quarters

**87.991 Graduate Research Report II (2-4 q.h.)**

Continuation of 87.990. *Prep.* 87.990.

Yearly, All Quarters

**87.992 MLS Thesis (2-6 q.h.)**

Yearly, All Quarters

**90.821 Biochemistry I (2 q.h.)**

Description of the components of biochemistry, including the chemistry of carbohydrates, lipids, prostaglandins, steroid hormones, amino acids, polypeptides, proteins, purines, pyrimidines, nucleosides, and nucleic acids. Consideration of Henderson-Hasselbalch expression, buffers, and importance of pKa. *Prep.* two quarters of *Organic Chemistry*.

Yearly, Summer and Fall Quarters

**90.822 Biochemistry II (2 q.h.)**

Discussion of enzymes, enzyme kinetics, and mechanisms of enzyme reactions. An introduction to the methods used for intermediary metabolism, bioenergetics, biological oxidation-reduction reactions, and the electron transport chain. A consideration is made of carbohydrate metabolism, including the citric acid cycle, the Embden Meyerhoff pathway, and the pentose phosphate pathway. Use of isotopes in biochemistry and the role of high-energy phosphate compounds are outlined. *Prep.* 90.821.

Yearly, Winter Quarter

**90.823 Biochemistry III (2 q.h.)**

Lipid metabolism is presented, including the fatty acid cycle, the biosynthesis of fatty acids, and the biological formation of the prostaglandins, cholesterol, and steroid hormones. The metabolism of the various amino acids is considered, including the urea cycle, one-carbon fragments, transamination reactions, and aromatic hydroxylations. Metabolism of nucleic acids and their building blocks are discussed, as well as the genetic basis of protein synthesis, the genetic code, and the mechanisms of control. *Prep.* 90.822.

Yearly, Spring Quarter

**90.824 Applications of Mass Spectrometry (2 q.h.)**

A comprehensive examination of the principles governing the fragmentation of organic molecules, the interpretation of mass spectra and discussion of applications of mass spectrometry to the solution of selected problems in the fields of chemistry, biochemistry and forensic sciences. *Prep.* 1 year *Organic Chemistry*, *Basic Physics*, *Physical Organic Chemistry* desirable but not essential.

Yearly, Summer Quarter

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## ACADEMIC CALENDAR 1976—1977

### Fall Quarter 1976

Registration period		
Burlington	Tuesday—Wednesday	Sept. 14—15
Boston	Monday—Thursday	Sept. 20—23
Interview period for new students by appointment*	Monday—Thursday	Sept. 20-23
Classes begin	Monday	Sept. 27
Examination period	Monday—Saturday	Dec. 13—18

### Winter Quarter 1976—1977

Registration period		
Burlington	Tuesday	Nov. 30
Boston	Monday—Thursday	Dec. 6—9
Interview period for new students by appointment*	Monday—Thursday	Dec. 6—9
Classes begin	Monday	Jan. 3
Examination period	Monday—Saturday	Mar. 21—26

### Spring Quarter 1977

Registration period		
Burlington	Tuesday	Mar. 8
Boston	Monday—Thursday	Mar. 14—17
Classes begin	Monday	Apr. 4
Last day to file card for Spring Commencement	Friday	Apr. 1
Last day to pay fee for Spring Commencement	Friday	Apr. 29
Final grades due in Registrar's Office for June graduates	Friday	June 3
Examination period	Monday—Saturday	June 13—18
Spring Commencement	Sunday	June 19

### Summer Quarter 1977

Registration period		
Burlington	Monday—Tuesday	June 13—14
Boston	Wednesday—Thursday	June 15—16
Interview period for new students by appointment*	Wednesday—Thursday	June 15—16
Classes begin	Monday	June 27
Last day to file card for Fall Commencement	Friday	July 1
Last day to pay fee for Fall Commencement	Monday	Aug. 1
Examination period	Wednesday—Thursday	Aug. 3—4

\* Appointments for interviews with new students must be made at least four days before the date of the interview.

† Examinations for day classes will be held in accordance with the undergraduate examination schedule.

## UNIVERSITY HOLIDAYS 1976—1977

Columbus Day	Monday	October 11
Veterans' Day	Thursday	November 11
Thanksgiving Recess	Thursday—Saturday	November 25—27
Christmas Vacation	Monday—Saturday	Dec. 20—Jan. 1
Martin Luther King Day	Saturday	January 15
Washington's Birthday	Monday	February 21
Patriot's Day	Monday	April 18
Memorial Day	Monday	May 30
Independence Day	Monday	July 4
Labor Day	Monday	September 5

## Equal Opportunity Policy

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees.

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1976—1977

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# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature by special enactment has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of nearly 180 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922); Liberal Arts (1935); Education (1953); Pharmacy (1962); Nursing (1964); Boston-Bouvé College (1964); the College of Criminal Justice (1967); and by Lincoln College's daytime Bachelor of Engineering Technology program (1971). This educational method enables students to gain valuable practical experience as an integral part of their college program and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses — offered by the University since 1906 — and adult-day courses leading to the bachelor's degree. In addition to offering day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The ten graduate and professional schools of the University offer day and evening programs leading to the degrees listed.

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.

The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science.

The Graduate School of Business Administration offers the degree of Master of Business Administration.

The Graduate Program in Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degree of Master of Education and Doctor of Education and the Certificate of Advanced Graduate Study.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer degree, Doctor of Engineering, and Doctor of Philosophy.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

### **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established in 1960 to relate the University to the needs of its community in a period of accelerated change. Adult education programs offered by the Center and University College have since been consolidated. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

### **RESEARCH ACTIVITIES**

The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning takes place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

# **buildings and facilities**

## **MAIN CAMPUS**

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intrastate lines, and MBTA subway-bus service within the metropolitan-suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 48 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## **Ell Student Center**

The Carl S. Ell Student Center provides facilities for student recreation and for extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the Center. Also included are special drama facilities, a ballroom, main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

## **Libraries**

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Burlington; the School of Law Library; and divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, Mathematics and Psychology, Health, Physical and Recreation Education, and Physical Therapy. There are additional subject collections for the Center for Management Development at Andover, Massachusetts, and the Marine Science Institute in Nahant.

The library collections number 400,000 volumes supplemented by some 333,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,700 periodical titles, 100,000 documents, and 4,600 sound recordings.

### **Cabot Physical Education Center**

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. It contains four basketball courts, an athletic cage, a women's gymnasium, and a rifle range, as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouvé College.

A recent addition to the center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball courts, and shower and dressing facilities.

### **Dockser Hall**

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

### **Apartments for Upperclass Students**

The University maintains a 100-apartment housing unit which accommodates 279 people. Two-, three-, and four-party apartments are available which vary in size from two to four rooms plus bath. Apartments are furnished with beds, chairs, desks, stove, refrigerator, and kitchen table. The cost includes all utilities.

A \$100 deposit is required when making application for the apartments. Applications are available in the Office of University Housing. Students are expected to make such arrangements on a term-to-term basis but may live in the apartments both while on cooperative work assignments and in school if they wish. All reservations are made on a first-come, first-served basis.

## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, physics, mathematics, business administration, science, education, and the arts, portions of undergraduate programs leading to the associate and bachelor's degrees, special programs for adults, and noncredit state-of-the-art programs are offered.



### **Warren Center**

The Warren Center is a practical laboratory for Boston-Bouv  College in outdoor education and conservation, in group practicum, and in camping administration, programming, and counseling. At this Center in Ashland, completed in 1967, there are tennis courts, field hockey and lacrosse fields, waterfront for swimming and boating, overnight camp sites, fields and forests, heated cottages, the Hayden Lodge with a recreation hall, library, crafts shop, dining facilities, and conference accommodations.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.

### **Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility primarily engaged in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at this institute are applicable toward an advanced degree in biology or health science.

### **Government Center Campus**

With the cooperation of the Federal Executive Board, the Graduate School of Liberal Arts' Department of Political Science offers an entire Master of Public Administration program at the John F. Kennedy Building in downtown Boston. This program is primarily for individuals employed in Federal, state, or local civil services.

### **Brockton, Nashua, and Framingham Campuses**

For students residing in southeastern Massachusetts and northeastern Rhode Island, the Graduate School of Business Administration offers a significant portion of its M.B.A. Program at facilities in Brockton, Massachusetts. These facilities, made available by the Knapp Corporation, are located on West Chestnut Street in Brockton.

Students residing in the southern New Hampshire area may take a significant portion of the M.B.A. Program at facilities in Nashua, New Hampshire. These facilities are furnished by Sanders Associates, Inc. and are located in their headquarters on Route 3, just over the Massachusetts line.

For students in the Framingham-Worcester area, a significant portion of the M.B.A. Program may be taken at classroom facilities located in Framingham, Massachusetts.



# regulations of the graduate school of engineering

The Master of Science degree may be earned in Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, Mechanical Engineering, and Engineering Management. In addition, there are programs leading to the Doctor of Philosophy degree in Chemical Engineering, Civil Engineering, Electrical Engineering, and Mechanical Engineering. The Doctor of Engineering degree is offered in Chemical Engineering. The Engineer degree may be earned in Electrical Engineering, Mechanical Engineering, and Industrial Engineering.

## Cooperative Programs

A unique feature of Northeastern's Graduate School of Engineering is the full-time Cooperative Education Plan. This program adopts the philosophy that a balanced exposure to theory and practice will provide students with a more meaningful education.

All engineering graduate departments offer full-time programs on the Cooperative Plan. The program includes nine months of classroom study and twelve months of work experience in an industrial concern. The cooperative student is able to gain vital experience in a professional environment while also supplementing his tuition payments.

The University has a full-time experienced staff to assist the student in obtaining a cooperative work assignment. The student may also wish to investigate employment opportunities on his own in order to facilitate final placement by the graduate coordinator.

An illustration of term sequence within the two-year Cooperative Education Plan is shown below:

	<b>First Year</b>	<b>Second Year</b>
Fall Quarter	class	work
Winter Quarter	work	class
Spring Quarter	class	work
Summer Quarter	work	

Normally, the Cooperative Plan operates as shown above. Economic conditions, the military, citizenship, and other factors may cause a departure from the normal Plan. Students who are admitted to a masters degree program under the Cooperative Plan must complete, through satisfactory performance, each cooperative work assignment in order to be eligible for their degree.

### **Engineering Sponsorships (Beginning Academic Year 1975)**

Another aspect of Cooperative Education is the Engineering Sponsorship Program. This program provides students with exposure to academic theory and industrial experience. The sponsoring Company, by employing the students during cooperative work quarters, provides a monthly salary for the two (2) year period plus a tuition stipend.

All students who are accepted as full-time cooperative students are considered for Engineering Sponsorships. Notification will be received prior to April 15th if a student has been chosen for a sponsorship. Those students not chosen are still eligible for placement under the Cooperative Plan of Education.

## **GENERAL REGULATIONS**

The general regulations and minimum requirements for all graduate programs are established by the University Graduate Council. In some matters the committee of each graduate school is allowed discretion to establish regulations within limits defined by the council. The regulations and academic requirements which follow have been formulated in accordance with this general policy.

### **Application Procedures**

All applicants for cooperative full-time or continuous full-time study at the master's level should address inquiries to their respective departments or to the Graduate School of Engineering. Application forms and reference blanks will be mailed to the applicant. This material, together with the \$15.00 non-refundable application fee, necessary transcripts, two letters of recommendation, the Graduate Record Examination scores when required, and the results of the Test of English as a Foreign Language (required of all applicants whose native language is not English), should be returned to the Graduate School of Engineering Office as soon after January 15th as possible. The Admissions Committee will notify applicants as soon as their material is complete.

All applicants for part-time study at the master's level should request an application from the Graduate School of Engineering Office. The completed application, the non-refundable \$15.00 application fee and an official transcript should be sent to the graduate school no later than two weeks prior to the interview and registration period for the quarter in which the applicant plans to begin his program. The dates of the interview and registration periods are announced in the catalog (see academic calendar) and in the circular issued each July. Applicants will be notified by mail regarding acceptance. Mailed applications will be accepted up to two weeks prior to the registration period for the quarter in which the applicant plans to begin the program.

If an applicant is unable to submit the application material by mail at least two weeks prior to the registration period, he should call the Graduate School Office to arrange for a personal interview to determine his qualifications for admission. The application, the non-refundable \$15.00 application fee and the official transcript may be submitted at the interview.

In some cases, the Graduate Record Examination may be required of applicants. The examination is administered by the Educational Testing Service, Box 955, Princeton, New Jersey, 08540. Applicants must make their own arrangements with the Educational Testing Service for the examination.

Test scores for Graduate Record Examinations and Test of English as a Foreign Language sent to the Graduate School of Engineering are retained for only one year from the date they were taken. If an applicant does not enroll in the quarter for which he was accepted, but delays his registration for a period of one year or more from the date that he originally took his examinations, he must repeat the examinations or resubmit the original test scores before he will be permitted to register.

### **Transcripts**

Official transcripts of previous college training must be supplied with the mailed application if an admissions decision is to be rendered by return mail, or submitted at the personal interview. If this is not feasible, the official transcripts must be mailed to the Graduate School of Engineering as soon after the initial registration as possible. Students who have attended institutions outside of the United States should provide comparable certified documents. Failure to file the necessary transcripts will result in the student being asked to withdraw.

### **Admission**

To be admitted for graduate work, an applicant must have obtained a Bachelor of Science degree in engineering or a closely related science from a recognized college or university with an acceptable quality of undergraduate work. His scholastic record, therefore, must show ability to pursue creditably a program of graduate study, and his undergraduate training must indicate breadth as well as adequate preparation in the field in which the applicant expects to do advanced work. Acceptance to the school is granted upon recommendation of the departmental graduate committee or its designate following a review of the application and supporting material. The recommendation is based upon promise of academic success and fulfillment of minimum criteria established by each department in the Graduate School of Engineering.

Students with an engineering or related science bachelor's degree, who are enrolled in another graduate school at Northeastern, may transfer to the Graduate School of Engineering. However, they must make application and

file the necessary documents, the same as transfers from other colleges or universities. The submission of registration materials for engineering course work does not constitute enrollment in the Graduate School of Engineering.

### **Registration**

Students must register within the dates and times listed on the school calendar. The place of registration will be announced prior to each period.

Auditors are not permitted. All students attending any course in the Graduate School of Engineering must be officially registered by the Registrar and listed on the class roster.

### **Residence**

All work for advanced degrees must be completed at the University unless approval has been obtained from the director of the graduate school for work taken elsewhere. Students who are in residence and are using the facilities of the University must register for such work.

### **Programs of Study**

The curricula of the degree programs are given under each departmental heading. The descriptions of courses offered by the several departments are given so that prospective students may obtain a view of the course coverage. Preparation courses are indicated when necessary. Not all courses are offered every year, but the course offerings will be arranged in such a manner that students may make continuous progress toward the degree.

The Graduate School of Engineering issues a circular close to July 1st which gives the courses for the following academic year and the times at which they meet.

The number of students enrolled in each class will be limited to permit effective teaching at the graduate level. The University reserves the right to cancel, postpone, combine, or modify any course.

At the time of his first registration, each full-time student must develop, with the assistance of his faculty adviser, a complete program of study for the degree for which he is registered. All subsequent changes must be approved by his faculty adviser.

Part-time students will be expected to complete the required courses outlined by each department, after which the elective courses may be undertaken. The study load for such students is limited to a program of two courses per quarter (one course in the summer) unless special permission to carry a heavier load is given by the director of the graduate school.

## Grading System

The performance of students in graduate courses will be recorded by the instructor by use of the following grades:

**A Excellent**

This grade is given to those students whose performance in the course has been of very high graduate caliber.

**B Satisfactory**

This grade is given to those students whose performance in the course has been at a satisfactory level.

**C Fair**

This grade is given to those students whose performance in the course is not at the level expected in graduate work.

**F Failure**

This grade is given to those students whose performance in the course is unsatisfactory.

In addition, the following letter designations are used:

**I Incomplete**

This grade is given to those students who fail to complete the work of the course.

**S Satisfactory without quality designation.**

**U Unsatisfactory without quality designation.**

These grades are used for the first quarter of a two-quarter sequence in which the grade for the second quarter applies to both the first and second quarters of the sequence. The designations S and U may also be used for thesis and seminar work.

## Incomplete Grades

The I grade will be changed to a letter grade upon removal of the deficiency which caused the grade of I to be reported. Deficiencies must be made up within the quarter following that for which the grade of I is received unless an extension of time is granted by the instructor. However, such extension of time may not exceed two additional consecutive calendar quarters.

Any student who wishes to make-up a final examination must obtain permission from the director of the graduate school by the second week of the quarter succeeding that in which the examination was missed. The make-up examination must be taken in that succeeding quarter unless circumstances warrant permission of the director to defer it to one of the next two quarters.

A student who has attained an inordinate number of incompletes may, at the discretion of the Committee on Graduate Study in Engineering be asked to withdraw for failure to show continuous progress toward the degree.

### **Class Hours and Credits**

All credits are entered as quarter hours. A quarter hour of credit is equivalent to three fourths of a semester hour credit. All classes meet on a quarter basis. In the summer session, classes meet for six-week periods. The academic calendar in the front of this catalog should be consulted for the opening and closing dates of each academic quarter.

### **Continuity of Program**

Students are expected to maintain continuous progress toward the degree. Any student who has not attended the Graduate School of Engineering for a period of one year must apply to the director for readmission.

### **Withdrawals**

In order to withdraw from a course, a student must fill out an official withdrawal form obtained at the Registrar's Office or at the Suburban Campus Office. Withdrawals may be made through the ninth class meeting of the quarter. Students will be withdrawn as of the date on which they fill out the official withdrawal form. Ceasing to attend a class or notifying the instructor does not constitute an official withdrawal.

Requests for withdrawal from a course after the ninth class meeting of the quarter may be submitted to the Director of the Graduate School, and may be approved to avert unusual hardships on a student.

### **Changes in Requirements**

The continuing development of the graduate school forces frequent revision of curricula. In every new bulletin some improvements are indicated. When no hardship is imposed on the student because of changes, and when the facilities of the school permit, the student is expected to meet the requirements of the latest bulletin. If the student finds it impossible to meet these requirements, the bulletin for the year in which he entered becomes the binding one.

### **Filing for the Degree**

Each student who plans to graduate either in June or September must submit to the Registrar's Office a completed commencement data card prior to the deadline listed in the academic calendar for that commencement at which he expects to receive the degree. If the deadline for filing is not met there is no assurance that the degree will be awarded that year. The commencement data card is supplied with the registration materials or is available in the Registrar's Office.



## THE MASTER'S DEGREE

### Admission

Specific requirements for each degree program will be found in the appropriate paragraphs for each academic department in the Graduate School of Engineering. General Requirements are listed under *Application Procedures*.

### Academic Classifications

Students initially entering the Graduate School are classified into one of three groups according to their admission qualifications.

Regular students are those who meet in full all admittance criteria based on the standards established by the Committee on Graduate Study in Engineering.

Provisional students are those whose records are above the minimum required for acceptance but do not qualify them for regular admission based on the standards established. Therefore, provisional students must obtain a B average in their first 12 quarter hours of course work to continue in the graduate school and be reclassified as regular.

Special students are those who do not wish to pursue a master's degree program or who may already possess the master's degree. Special students with only the bachelor's degree must meet the same admission criteria as the regular or provisional student and will be limited to a maximum of 12 quarter hours of graduate credits.

Any student whose record is not satisfactory may be dropped from the program regardless of his classification.

### Academic Requirements

A candidate for the master's degree must satisfactorily complete an approved program consisting of a minimum of 40 quarter hours of correlated work of graduate caliber and such other study as may be required by the department in which he is registered.

To qualify for the Master of Science degree from the Graduate School of Engineering each student must have an average grade accumulative of not less than B with no more than 12 credits below a B in all courses undertaken at Northeastern University. The Committee on Graduate Study in Engineering allows eight quarter hours of credit to be taken, in addition to the stated degree requirements, to repeat failed required courses or to substitute for elective courses to obtain the required B average for completion of degree requirements. The number of I grades that a student may accrue will be limited.

Within the above limitations for extra or repeated courses, a required course for which a grade of F is received must be repeated with a grade of C or better, and may be repeated only once. If a grade of F is received in an elective course, that course may be repeated once to obtain a grade of C or

better, or another elective course may be substituted for it. If a grade of C is received in a required course, that course may be repeated once to obtain a grade of B or better.

### **Comprehensive Examination**

At the discretion of the department, a final written or oral comprehensive examination may be required. Such examinations will be given at least two weeks before the commencement at which the degree is expected.

### **Thesis**

If a thesis is required in partial fulfillment of degree requirements, it must show independent work based in part upon original material, and must meet the approval of the departmental graduate committee.

The thesis must receive a grade of B or better to be accepted. Instructions for the preparation of the thesis may be obtained from the department.

### **Transfer Credits**

A maximum of 12 quarter hours of credit obtained at another institution may be accepted toward the master's degree provided that the credits transferred are in the candidate's field, consist of work taken at the graduate level for graduate credit, carry grades of A or B, have been earned at a recognized college or university, and have not been used toward any other degree. Students should petition the Graduate School of Engineering in writing for all transfer credits. Grades on transfer credits may not be used for the purpose of obtaining the academic average necessary for completion of the degree requirements.

### **Time Limitations**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years unless an extension is granted by the graduate school committee.

### **Fellowships**

The departments of the Graduate School of Engineering have two types of fellowships available. Some departments have teaching assistantships and research fellowships for students enrolled in work leading to the master's degree. The departments which give doctoral degrees also have research fellowships for such students.

### **Assistantships**

Some departments have teaching assistantships, on the Cooperative Plan, in which students alternate full-time academic work with full-time work in the department. Some departments also have available research fellowships. Applications for traineeships must be filed by March 15, with

o letters of recommendation and a transcript of all prior college work. All students must have their course program approved by the chairman of the respective department before the student registers.

### **Cooperative Programs**

All the departments offer the Cooperative Education Plan. The Plan consists of nine months of classroom study and twelve months of work experience in an industrial concern.

### **Full-Time Program**

All the departments offer a continuous full-time program in which the requirements for the master's degree can be completed in one academic year.

### **Part-Time Program**

Most of the departments offer part-time programs in which the admission requirements are the same as for full-time programs. However, the program is established in such a way that students may progress according to their abilities and the time available. The curricula of the part-time programs are specified by the departments.

An official transcript of prior college work must be submitted with an application by those who apply by mail, or at the personal interview for those who apply after the deadline for mailing. Mail applications will be accepted up to two weeks prior to the registration period for the quarter in which the applicant plans to enter the Graduate School.

### **Honorary Societies**

Northeastern University has chapters of Tau Beta, Pi, Sigma Xi, and Phi Kappa Phi. Graduate students are eligible for consideration for election to these societies in accordance with the admission requirements of each organization.

## **THE DOCTOR OF PHILOSOPHY DEGREE**

The Doctor of Philosophy degree is awarded to candidates who give evidence of high attainment and research ability in their major field. The degree requirements are administered by committees in charge of each degree program. These committees may be departmental graduate committees or the committee of the graduate school, depending upon the nature of the program. It is the responsibility of the chairman of the committee to certify to the Graduate School of Engineering the completion of each requirement for each candidate.

### **Admission**

Each degree program has an established admission procedure for students starting their doctoral work at Northeastern University. Initial contact should be with the chairman of the appropriate department.

### **Classification and Degree Candidacy**

Students taking advanced graduate work are classified as follows:

1. **Doctoral Student**

Students in this classification have been admitted to a doctoral program.

2. **Doctoral Degree Candidate**

Students in this classification are doctoral students who have completed 40 quarter hours of acceptable graduate work beyond the bachelor's degree and have passed the qualifying examination.

3. **Special Students**

This classification is given to students taking advanced graduate work who are not enrolled for a master's degree, and who have not been admitted to a doctoral program.

### **Residence Requirement**

Candidates for the Doctor of Philosophy degree must spend the equivalent of at least one academic year in residence at the University taking graduate work. The committee of each degree program specifies the method by which the residence requirement is satisfied.

### **Qualifying Examination**

Students must pass a qualifying examination within time limits set by the committee of the degree program. The material covered in the qualifying examination and the level of course work necessary to prepare for the examination are established by the committee for each program.

### **Comprehensive Examination**

Degree programs may require a comprehensive examination during the time in which a student is a degree candidate. The purpose of this examination is to test the knowledge and skills of the student in a particular area and his knowledge of recent research developments in his field.

### **Course Requirements**

The minimum course requirements of 40 quarter hours constitute the work normally required for a master's degree. The course requirements beyond this are the doctoral course requirements and the amount of such work necessary in each doctoral program is specified by the committee in charge of the doctoral program.

### **Dissertation**

Each doctoral student must complete a dissertation which embodies the results of extended research and makes an original contribution to the field. This work should give evidence of the candidate's ability to carry out independent investigation and interpret in a logical manner the results of the

research. The method of approval of the dissertation is established by the committee in charge of the degree program. The original bound copy of the dissertation must be deposited in the library.

### **Language Requirement**

The foreign language requirement and how it is satisfied is established by the committee in charge of each degree program.

### **Final Oral Examination**

The final oral examination will be taken after completion of all other requirements for the degree. This examination must be held at least two weeks before the commencement at which the degree is to be awarded.

The committee for the final oral examination for the doctoral degree is appointed by the committee in charge of the degree program, and the director of the graduate school is notified of the time of the examination.

The final oral examination will be on the subject matter of the doctoral dissertation and significant developments in the field of the dissertation. Other fields may be included if recommended by the examining committee.

### **Transfer Credit**

If transfer credit for doctoral course work is desired, approval for such transfer credit must be given by the committee in charge of the degree program.

### **Time Limitation**

After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements. If a student wishes to obtain a time extension, he may, with the approval of the committee of his degree program, petition the Committee on Doctoral Degree Programs of the University Graduate Council for such extension.

### **Registration**

All students must register for course work or dissertation as approved by their advisers or the departmental registration officer. After the first registration for doctoral work, registration must be continuous unless withdrawal is allowed by the committee in charge of the degree program. Students must be registered for dissertation during the quarter in which they take the final oral examination.

## **THE DOCTOR OF ENGINEERING DEGREE**

The Doctor of Engineering degree is awarded to candidates who give evidence of high attainment and ability in their major field. The degree requirements are administered by committees in charge of each degree program. These committees may be departmental graduate committees or the committee of the graduate school, depending upon the nature of the

program. It is the responsibility of the chairman of the committee to certify to the Graduate School of Engineering the completion of each requirement for each candidate.

### **Admission**

Each degree program has an established admission procedure for students starting their doctoral work at Northeastern University. Initial contact should be with the chairman of the appropriate department.

### **Classification and Degree Candidacy**

Students taking advanced graduate work are classified as follows:

1. Doctoral Student

Students in this classification have been admitted to the doctoral program.

2. Doctoral Degree Candidate

Students in this classification are doctoral students who have completed 40 quarter hours of acceptable graduate work beyond the bachelor's degree and have passed the qualifying examination.

3. Special Students

This classification is given to students taking advanced graduate work who are not enrolled for a master's degree, and who have not been admitted to a doctoral program.

### **Residence Requirement**

Candidates for the Doctor of Engineering degree must spend the equivalent of at least one academic year in residence at the University taking graduate work. The committee of each degree program specifies the method by which the residence requirement is satisfied.

### **Qualifying Examination**

Students must pass a qualifying examination within time limits set by the committee of the degree program. The material covered in the qualifying examination and the level of course work necessary to prepare for the examination are established by the committee for each program.

### **Comprehensive Examination**

Degree programs may require a comprehensive examination during the time in which a student is a degree candidate. The purpose of this examination is to test the knowledge and skills of the student in a particular area and his knowledge of recent research developments in this field.

### **Course Requirements**

The minimum course requirements of 40 quarter hours constitute the work normally required for a master's degree. The course requirements

beyond this are doctoral course requirements, and the amount of such work necessary in each doctoral program is specified by the committee in charge of the doctoral program.

### **Dissertation**

The dissertation for the Doctor of Engineering degree is fundamentally different from that of the Doctor of Philosophy degree. In general, the latter focuses on contributions to new knowledge in the engineering sciences and is expected to demonstrate the student's competence as a researcher. The dissertation for the Doctor of Engineering degree focuses on creative engineering design and in-depth engineering studies. It may, and usually will, contain elements that involve research, but above all, it must demonstrate the student's ability to work creatively on engineering analysis and design problems such as those encountered in professional practice.

### **Language Requirement**

There is no foreign language requirement, but, in lieu of such a requirement, the student must demonstrate proficiency in computer software techniques and an acceptable machine language.

### **Final Oral Examination**

The final oral examination will be taken after completion of all other requirements for the degree. This examination must be held at least two weeks before the commencement at which the degree is to be awarded.

The committee for the final oral examination for the doctoral degree is appointed by the committee in charge of the degree program, and the rector of the graduate school is notified of the time of the examination.

The final oral examination will be on the subject matter of the doctoral dissertation and significant developments in the field of the dissertation. Other fields may be included if recommended by the examining committee.

### **Transfer Credit**

If transfer credit for doctoral course work is desired, approval for such transfer credit must be given by the committee in charge of the degree program.

### **Time Limitation**

After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements. If a student wishes to obtain a time extension, he may, with the approval of the committee of his degree program, petition the Committee on Doctoral Degree Programs or the University Graduate Council for such extension.

### **Registration**

All students must register for course work or dissertation as approved by their advisers or the departmental registration officer. After the first

registration for doctoral work, registration must be continuous unless withdrawal is allowed by the committee in charge of the degree program. Students must be registered for dissertation during the quarter in which they take the final oral examination.

### **Professional Experience**

The student is required to present evidence of at least one calendar year of experience in engineering practice at a suitable professional level. This experience must have been acquired after completion of a bachelor's degree in a branch of engineering. The committee in charge of each degree program specifies the details of the professional experience requirement.

## **INTERDISCIPLINARY PROGRAMS**

Some graduate students may wish to pursue doctoral programs which involve substantial work in two or more departments. To meet this need, an interdisciplinary program may be established which corresponds in scope and depth to doctoral standards, but does not agree exactly with the individual departmental regulations. For such possibilities, the following plan is in operation:

### **Admission**

Application for admission to interdisciplinary doctoral study consists of the submission of a carefully thought-out written proposal describing the areas of proposed study and research. The proposal may be a part of the initial application for admission to graduate study at Northeastern University, or it may be submitted by a student already enrolled. It may be directed to a doctoral degree-granting department or to the director of the graduate school, who directs it to the appropriate department. In either case, admission to interdisciplinary doctoral study requires favorable recommendation by the sponsoring doctoral degree-granting department and approval by authorized representatives of the graduate study committees of the departments appropriate to the disciplines covered by the applicant's proposal. The sponsoring department becomes the registration base of the student.

### **Formation of Interdisciplinary Committee**

A student who has been accepted for interdisciplinary study must obtain the consent of an adviser who will direct his doctoral thesis. This adviser who may or may not be a member of the registration department, will be chairman of the interdisciplinary committee for this student. A second member will be appointed from the registration department by its chairman. These two members will obtain one or more additional members or request the director of the graduate school to do so. At least two departments must be represented on the committee and a majority of the committee must come from doctoral degree-granting departments. The chairman of the registration department will notify the director of the



graduate school of the membership of the committee as soon as arrangements are complete.

### **Duties of Interdisciplinary Committee**

A member of the interdisciplinary committee who is also a member of the registration department will serve as the registration officer to approve the course registration for the student. A copy of the approved course registration must also be filed with the other committee members and with the graduate study committee of the registration department.

The interdisciplinary committee will be responsible for the administration of the qualifying examination, language examination, approval of the dissertation, and comprehensive examination. This committee must also certify to the registration department the completion of the requirements for the award of the doctoral degree.

The interdisciplinary committee must assure that the program of the student represents standards comparable to those of the registration department and that the program is not so broad that it has inadequate depth in any area.

The program of the student may be reviewed at any time by the director of the graduate school to determine whether objectives of the program are being met.

## **THE ENGINEER DEGREE**

The degree of Engineer is intended for those who do not wish to make a commitment to post-master's degree graduate study that is as extensive as that required for one of the doctor's degrees. It is an intermediate degree, between master's and doctor's degrees. A student who has completed the engineer degree is eligible to apply for admission to a doctor's degree program.

### **Admission**

Each departmental Engineer degree program has its own admission procedure for students beginning the program. Normally a master's degree in engineering or related field is required. Initial contact should be with the chairman of the appropriate department.

### **Classification and Degree Candidacy**

A student admitted to the Engineer degree program will be designated as a candidate for this degree.

### **Residence Requirement**

Candidates for the Engineer degree must spend the equivalent of at least two academic quarters in residence at the University taking graduate work. The committee of each degree program specifies the method by which the residence requirement is satisfied.

### **Qualifying and Comprehensive Examinations**

The committee for each Engineer degree program specifies its own examinations. Normally, no qualifying examination is required for candidacy and no comprehensive examination is required for completion, but individual departments offering the degree may require such examinations.

### **Course Requirements**

The minimum course requirement will be 40 quarter hours beyond the master's degree, with no more than 10 quarter hours of credit out of the 40 allowed for work on the dissertation. A minimum of 20 quarter hours must be taken in the department in which the degree is offered. Specific course requirements for each Engineer degree program are determined by the departmental committee in charge of the program.

### **Dissertation**

Each Engineer degree student must complete a dissertation which demonstrates a high level of competence in engineering research, development, or design. As a general guideline, the amount of effort normally expected will be the equivalent of about 10 quarter hours of graduate course work.

### **Language Requirement**

No foreign language is required for the Engineer degree.

### **Final Oral Examination**

A final oral examination may be required by the departmental committee in charge of the Engineer degree program. The examination will normally consist of a defense of the dissertation.

### **Transfer of Credit**

Approval for transfer of credit must be given by the departmental committee in charge of the degree program.

### **Time Limitation**

After admission to the program, a maximum of five years will be allowed for completion of the degree requirements. Extension of this time limit may be granted with the approval of the departmental committee in charge of the degree program.

### **Registration**

All students must register for course work or dissertation as approved by their advisers or the departmental registration officer. After the first registration for this work, registration must be continuous unless withdrawal is allowed by the departmental committee in charge of the degree program.

# financial information

## FINANCIAL OBLIGATIONS

### Tuition

Tuition rates and fees are subject to revision by the Board of Trustees at any time. However, any change in tuition and fees will become effective at the beginning of the school year which follows the one in which the change was announced.

The tuition rate for all graduate students is \$67 per quarter hour of credit. Doctoral candidates actively utilizing the resources of the University in their Doctor of Philosophy or Doctor of Engineering dissertation are charged an additional \$600 per quarter. Those doctoral candidates registered for dissertation work to be performed off campus are charged \$200 per quarter in addition to tuition. Degree candidates that are no longer full time students yet still need to complete thesis or dissertation requirements will be charged a continuation fee. This will entitle the student to limited access of various University facilities and privileges.

Tuition statements are mailed to students by the Bursar's Office and are payable by cash or check to Northeastern University on or before the date specified.

### Fees

A \$15.00 non-refundable application fee must accompany the application for admission to the Graduate School of Engineering. No applications will be processed until the fee has been received.

Upon notification of acceptance, all full-time applicants are required to pay a tuition deposit of \$50.00. This deposit will be credited to the student's tuition, and it is not refundable for those who do not register.

Other fees include a charge of \$10 for late payment of tuition and a commencement fee of \$25 for all degree candidates, payable before commencement by the date listed in the academic calendar.

For full-time students there is a charge of \$12.50 per quarter for the services available in the Student Center. The fee for teaching assistants and research fellows is \$6.25 each quarter. All part-time students on the Huntington Avenue Campus are charged \$.75 a quarter.

All full-time students pay a non-refundable University Health Service fee of \$120 each year. This fee will provide Blue Cross-Blue Shield coverage and entitle the students to the medical care furnished by the University Health Services.

All financial obligations to the University must be discharged by graduation.

## Refunds

Tuition refunds will be granted only on the basis of the date appearing on the official withdrawal form filed by the student. Nonattendance does not constitute official withdrawal. Questions regarding refunds should be discussed with the Bursar's Office.

Refunds will be granted in accordance with the following schedule:

Amount of Refund:	
Official Withdrawal Filed Within:	Percentage of Tuition
First week of quarter	100
Second week of quarter	75
Third week of quarter	50
Fourth week of quarter	25

## FINANCIAL AID

The Graduate School of Engineering has available the following types of assistantships and fellowships for support of graduate students. Those interested in financial aid must apply through the chairman of the major department. The chairmen or representatives of the Department are listed in the catalog under the Committee on Graduate Study in Engineering.

### Teaching Assistantships

Teaching assistantships allowing remission of tuition and a stipend are available in all departments. Holders of such awards devote half time to academic assistance directly related to the teaching function and the balance to course work.

### Graduate Administrative Assistantships

Some University departments offer the graduate student an opportunity for remission of tuition and a stipend in return for half time spent in assisting with non-teaching, administrative duties.

### Tuition Assistantships

Many departments provide remission of tuition for students who share in the administrative work of the department. These awards are normally given to full-time students in the first year of graduate work.

### Research Fellowships

A number of departments offer research fellowships including N.I.H. and N.S.F. that carry a stipend and remit tuition. Certain of these grants require half-time work on research in the department, with the remaining time devoted to course work. Others provide for full-time work on research used for thesis or dissertation.

### **Doctoral Research Fellowships**

In the departments which give work leading to the Ph.D. degree, research fellowships available for students who have established candidacy for the Ph.D. degree carry a higher stipend than fellowships at the master's level.

### **Appointments**

Appointments to fellowships and assistantships are ordinarily announced no later than April 15 for the following academic year or summer. Appointments are for a maximum of one year and are not automatically renewed. Students who hold assistantships and research fellowships are expected to devote full time to their studies and the duties of the grant. They may not accept outside employment without the consent of their faculty advisers and the director of the graduate school.

## **FINANCIAL AID OFFICE**

The Office of Financial Aid offers two types of assistance to graduate students: the National Direct Student Loan and Work-Study. All awards are based on financial need. Aid granted from these programs sponsored by the Federal Government is dependent upon the amount of funds allocated to Northeastern University.

### **National Direct Student Loan**

Under the National Direct Student Loan program, students may be allowed to borrow as much as \$1500 per academic year; however, the total amount borrowed must not exceed \$10,000 for the student's entire undergraduate and graduate program. Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load. The repayment of the principal may be extended over a ten-year period with an interest rate of 3% per annum.

### **College Work Study Program**

The College Work-Study Program is sponsored by the Federal Government. It is designed to give students an opportunity to earn as much as \$3.50 per hour working in jobs on or off campus in public or private non-profit organizations. This program is administered solely by the Office of Financial Aid and is not to be confused with the University's cooperative education program.

### **Martin Luther King, Jr. Scholarships**

Established in 1969 in memory of the late Rev. Martin Luther King, Jr., awards are made as openings occur to qualified minority graduate students who show financial need and are accepted to full-time study in the Graduate Schools of the University. Stipends will cover tuition and all fees.

### **Guaranteed Student Loan Program**

A prime means of financial assistance is the Guaranteed Student Loan Program. Because of the easy availability of this loan relative to other types of financial assistance, it is recommended that all applicants for aid first seek assistance from this source. Students may receive guaranteed loans of up to \$2500 per academic year from their local banks. Repayment of the principal and interest need not begin until nine months after the student ceases to carry at least a half-time academic load.

Northeastern University is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form in order to be considered. This form may be obtained from the financial aid officer at the institution which the student now attends or from the Northeastern University Office of Financial Aid. All sections of the GAPSFAS form must be completed and sent to the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540. No decision on an application for financial aid will be made until the GAPSFAS form is received.

Only students who have been officially accepted as degree candidates to a graduate school of Northeastern University may apply for financial aid. The University does not award financial assistance to students who are not citizens or permanent residents of the United States.

The Office of Financial Aid does not award Graduate Assistantships or Fellowships. For further information regarding such assistance, students should contact the Chairmen of the major department.

### **National Defense Student Loans**

This program is available to students who are carrying at least one-half the normal academic load, are accepted as degree candidates, and who show evidence of financial need.

The Federal maximum a graduate student may borrow is \$5000 while pursuing his post-baccalaureate degree.

Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load at an institution of higher education. The repayment of principal may be extended over a ten-year period with the interest at the rate of 3% per annum. Repayment may be deferred up to a total of three years while a borrower is serving as a Peace Corps or VISTA volunteer.

Additional information and application forms are available from the Office of Financial Aid. The application deadline is September 1 for full-time students. For other students the deadline is six weeks prior to the start of the quarter for which aid is requested.

### **Dormitory Proctorships**

A number of proctorships in dormitories on or near the Huntington Avenue campus are available each year. Appointments carry a minimum compensation of room and board. Further information and application forms may be obtained from the Office of University Housing.

# faculty

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 Raymond Colvin, *Lecturer in Engineering*  
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 Austin W. Fisher, B.S., Sc.D., *Professor of Engineering Management*  
 Eugene B. Foley, B.S., M.S., *Lecturer in Engineering*  
 Arthur R. Foster, B.S., M.Engg., *Professor of Mechanical Engineering*

## 44 / FACULTY

David R. Freeman, B.S., M.S., Ph.D., *Professor of Industrial Engineering and Chairman of the Department*  
Maurice Gertel, B.S., M.S., *Lecturer in Engineering*  
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 Bernard T. Woodrow, B.S., M.S., *Lecturer in Engineering*  
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 Joseph J. Zelinski, B.S., Ph.D., *Professor of Mechanical Engineering*  
 John Zotos, B.S., M.S., Met.E., *Associate Professor of Mechanical Engineering*

# civil engineering

## **Admission**

To be enrolled for graduate work leading to the degree of Master of Science in Civil Engineering, applicants must have obtained a Bachelor of Science degree in Civil Engineering, with an acceptable quality of undergraduate work, from a recognized institution. Applicants with a Bachelor of Science degree from a recognized institution in some other engineering field or related science and an appropriate background of preparation may pursue this program and qualify for the degree of Master of Science.

## **THE MASTER'S DEGREE**

### **General**

The master's degree requirements can be completed on the Cooperative Plan, on a full-time basis or part-time in the evening. Forty quarter hours of academic work are required. A master's report carrying 4 Q.H. of credit, or a thesis of 8 Q.H. credit is required in all fields of civil engineering (environmental, structural and transportation).

A meaningful sequence of electives must be chosen which meets the approval of the department. Department interviews are necessary early in the program for all students in order that an approved program of electives may be arranged with the individual. It is suggested that only required courses be taken in the first quarter. During that quarter an interview should be scheduled within the department for preliminary planning of the remainder of the individual program.

### **Full-Time Program on the Cooperative Plan**

On the Cooperative Plan students enroll for academic work in the Fall and Spring Quarters of the first year and in the Winter Quarter of the second year. The other three quarters of the two academic years and the summer after the first year are available for professional employment. Students who are admitted to a master's degree program under the Cooperative Plan must complete, through satisfactory performance, each cooperative work assignment in order to be eligible for their degree.

### **Full-Time Program**

Arrangements may be made to complete the degree requirements in one year on a continuous full-time basis.

## Part-Time Programs

The admission requirements for these programs are similar to those for the full-time program, but students may progress according to their ability to combine their study load with their employment load. A maximum of seven years is allowed to complete the program.

## Substitutions

With the approval of the department, substitutions may be made for some of the prescribed courses by other courses in the department or in other departments which offer graduate work.

Students may petition to substitute eight quarter hours of approved course work for the required four quarter hours Master's Report.

## STRUCTURAL ENGINEERING

The Structural Engineering Program emphasizes basic courses in Structural Analysis, Design of Steel and Concrete Structure, and Soil and Rock Mechanics. Advanced topics in Dynamics, Stability, Models and Numerical Methods round out a comprehensive presentation which may be supplemented by offerings from other programs, such as mechanical engineering or industrial engineering.

### SPECIMEN DAY PROGRAM

Fall Quarter	Credits
1.847 Structural Analysis .....	4
1.853 Concrete Structures I .....	2
1.877 Eng. Props. of Soils .....	4
1.861 Design of Structures I .....	2
1.859 Structural Stability .....	2
or	
1.877 Eng. Props. of Soil .....	4
1.882 Engineering Geology .....	<u>2</u>
	(Minimum) 14

Winter Quarter	Credits
1.854 Concrete Structures II .....	2
1.862 Design of Structures II .....	2
1.884 Rock Mechanics I .....	2
1.894 Numerical Methods in Struct. Mechanics .....	4
1.897 Master's Report .....	4
or	
1.899 Thesis .....	<u>8</u>
	(Minimum) 14

**Spring Quarter****Credits**

1.855	Concrete Structures III	2
1.857	Structural Dynamics	4
1.863	Design of Structures III	2
1.878	Foundation Engineering	4
1.885	Rock Mechanics II	<u>2</u>

(Minimum) 12

The two-credit courses are scheduled for the early evening time block.

**PART-TIME PROGRAM****Required Courses****Credits**

1.897	Master's Report	4
	or	
1.899	Thesis	<u>8</u>

(Minimum) 4

**Electives (Part-time Program)**

Students in the Structural Engineering major must elect 30 quarter hours from civil engineering courses within the structural engineering field (courses in the 840-899 series).

Six quarter hours may be elected from any courses in engineering or science for which the student has the necessary preparation.

The electives will normally be available according to the following schedule:

**Fall Quarter****Credits**

1.841	Structural Analysis I	2
1.844	Structural Analysis IV	2
1.853	Concrete Structures I	2
1.859	Structural Stability	2
1.861	Design of Structures I	2
1.871	Eng. Props. of Soils I	2
1.874	Foundation Eng. I	2
1.882	Eng. Geology	2

**Winter Quarter****Credits**

1.842	Structural Analysis II.	2
1.850	Struc. Dynamics I	2
1.854	Concrete Structures II	2
1.862	Design of Structures II	2
1.872	Eng. Props. of Soils II	2
1.875	Foundation Eng. II	2
1.884	Rock Mechanics I	2
1.892	Numerical Methods in Struct. Mechanics I	2

**Spring Quarter****Credits**

1.843	Structural Analysis III	2
1.849	Model Analysis	2
1.851	Struct. Dynamics II	2
1.855	Concrete Structures III	2
1.863	Design of Structures III	2
1.873	Soils Testing Lab.	2
1.876	Foundation Eng. III	2
1.885	Rock Mechanics II	2
1.893	Numerical Methods in Struct. Mechanics II	2

**TRANSPORTATION ENGINEERING**

The Transportation Engineering Program is designed for students with career goals in transportation engineering, planning, or research. This program may consist of courses from engineering, liberal arts, and business. A minimum of 40 credit hours is required for a graduate degree.

A Master of Science in Civil Engineering degree will be awarded to students who have an accredited undergraduate degree in civil engineering and have completed at least 24 quarter credit hours in civil engineering courses, i.e. courses designated with 01. - numbers. A Master of Science degree will be awarded to students who do not have an undergraduate degree in civil engineering or who do not meet the minimum 24 quarter credit hour requirement in civil engineering courses. A student may elect to take non-technical electives in liberal arts and business administration. A maximum of nine credit hours in non-technical fields will be allowed.

Each student is required to prepare a program of study which must be reviewed and approved by his faculty adviser. A typical program of study would normally consist of courses shown in the specimen program. Specimen programs listed below for day and part-time students are intended to show the nature of the program. Substitutions for the courses listed in the specimen programs may be made depending on the student's interest, academic background, and career objectives.

For a complete listing of courses and course descriptions, consult appropriate sections of the graduate school catalogues for Engineering, Liberal Arts, and Business Administration. Further information can be obtained within this catalogue under *Graduate Program in Transportation*, which describes the interdisciplinary program in transportation leading to a Master of Science in Transportation degree.

**SPECIMEN DAY PROGRAM****Required Courses****Credits**

1.834	Transp. Analysis & Planning	4
1.800	Systems Analysis I	4
1.805	Traffic Flow Theory	4
1.837	Interdisciplinary Urban Transp. Seminar	2
1.839	Thesis (Transp.)	6

**Suggested Technical Electives**

<b>Courses</b>	<b>Credits</b>
1.206 Applied Probability for Civil Engineers . . . . .	4
1.820 Transp. Engineering . . . . .	2
1.806 Urban Transp. Analysis . . . . .	4
1.819 Environmental Impacts of Urban Transp. . . . .	4
1.801 Systems Analysis II . . . . .	4
5.960 Probability and Statistics I . . . . .	2
5.961 Probability and Statistics II . . . . .	2
5.962 Probability and Statistics III . . . . .	2
5.913 Data Processing for Engineers . . . . .	2
5.914 Advanced Operations Research . . . . .	4

**Suggested Non-Technical Electives**

<b>Courses</b>	<b>Credits</b>
22.847 Politics of Transportation . . . . .	3
39.9L5 Economics of Urban Transp. . . . .	3
39.9J8 Physical Aspects of Urban-Regional Development . . . . .	3
39.9P3 Regional Development . . . . .	3
39.9R1 Development Planning . . . . .	3
48.805 Urban Transp. Management . . . . .	3

**PART-TIME PROGRAM**

Part-time students are subjected to the same requirements as full-time students. Courses listed above may be taken by part-time students. Some of these courses are not available in the evening, but appropriate substitutions may be made. The following is a list of required courses:

**SPECIMEN PART-TIME PROGRAM**

<b>Required Courses</b>	<b>Credits</b>
1.834 Transp. Analysis & Planning . . . . .	4
1.800 Systems Analysis I . . . . .	4
1.805 Traffic Flow Theory . . . . .	4
1.838 Master's Report (Transportation) . . . . .	4
or	
1.839 Thesis (Transp.) . . . . .	6

See Specimen Day Program for suggested Technical and Non-Technical Electives.

**ENVIRONMENTAL ENGINEERING**

Includes areas of specialization such as water resources engineering, water and wastewater engineering, environmental health, air pollution control and solid waste management. A day program on the Cooperative Plan is available.

Part-time students and full-time students not on traineeships or grants-in-aid have the option of undertaking either a Master's Report for 4 Q.H. credit or a Master's Thesis for 8 Q.H. credit. (Students on traineeships or with grants-in-aid may be required to complete a Master's Thesis.)

Suggested programs for both full-time and part-time students are given below. Other programs, tailored to meet individual requirements, may be developed through conferences with the student's adviser.

### SPECIMEN DAY PROGRAM

First Academic Quarter	Credits
1.914 Water & Wastewater Treatment . . . . .	4
1.923 Environmental Chem. . . . .	4
1.933 Environmental Anal. . . . .	4
Elective . . . . .	<u>2</u>
	14

Second Academic Quarter	Credits
1.922 Env. Bacteriology . . . . .	2
Electives . . . . .	<u>12</u>
	14

Third Academic Quarter	Credits
1.912 Water & Wastewater Treatment III . . . . .	2
Electives . . . . .	6 or 2
1.993 Master's Report . . . . .	4
or	
1.991 Thesis . . . . .	<u>8</u>
	(Minimum) 12

### PART-TIME PROGRAM

Required Courses	Credits
1.910 Water & Wastewater Treatment I . . . . .	2
1.911 Water & Wastewater Treatment II . . . . .	2
1.912 Water & Wastewater Treatment III . . . . .	2
1.920 Env. Chemistry I . . . . .	2
1.921 Env. Chemistry II . . . . .	2
1.922 Env. Bacteriology . . . . .	2
1.930 Env. Analysis I . . . . .	2
1.931 Env. Analysis II . . . . .	2

These required courses may be waived for those students who have taken Northeastern course 1.223, Environmental Chemistry, or equivalent. Course 1.933 or courses 1.930 and 1.931 will be required of all students.

1.993	Master's Report .....	4
	or	
1.991	Thesis .....	8
		<hr/> 20 or 24

### Elective Groupings (Day and Part-Time)

Forty (40) quarter hours of academic work are required for the degree, including certain approved electives which are available from other departments. To provide a meaningful grouping of the available technical electives, one of the following sequences of courses must be selected. These are the required courses for each area of specialization. A minimum of 14 quarter hours of elective courses must be obtained from the environmental engineering courses offered by the Civil Engineering Department (900 series). Exceptions to these requirements must receive permission from the Graduate Environmental Committee.

#### Water and Wastewater Engineering Credits

1.935,	1.936 Environmental Lab (U.O.) .....	4
1.907	Environmental Statistics .....	2
1.954	Stream Sanitation .....	2
1.913	Ind. Waste Disposal .....	2
1.994	Environmental Eng. Seminar (Trainees Only) .....	2
	Additional Electives .....	4 or 8

#### Environmental Health Engineering & Science Credits

1.985	Environmental Protection .....	2
1.980	Environmental Planning and Management .....	2
1.950	Air Pollution .....	2
1.952	Ind. Hygiene .....	2
1.955	Air Sampling Analysis .....	2
	Additional Electives .....	8 or 12

#### Water Resources Engineering Credits

1.907	Env. Stat. ....	2
1.908,	1.909 Hydrology I, II .....	4
1.960,	1.961, 1.962 Hydr. Structures .....	6
1.901,	1.902, 1.903 Hydraulics .....	6
	Additional Electives .....	2

#### Air Pollution Engineering Credits

1.800	Systems Analysis I .....	4
1.950	Air Pollution .....	2
1.955	Air Sampling & Analysis .....	2
1.957	Air Science .....	2
	Additional Electives .....	6 or 10



### Civil Engineering (Geotechnical)

At the master's degree level it is possible to undertake concentrated study in geotechnical engineering which is concerned with materials within the earth's crust. Students with this interest should consider the following courses recommended by the Civil Engineering Department to obtain a competent knowledge in the field.

Courses	Credits
1.871 Eng. Prop. of Soils I . . . . .	2
1.872 Eng. Prop. of Soils II . . . . .	2
1.873 Soils Testing Lab. . . . .	2
1.874 Soil Mechanics and Foundation Eng. I . . . . .	2
1.875 Soil Mechanics and Foundation Eng. II . . . . .	2
1.876 Soil Mechanics and Foundation Eng. III . . . . .	2
1.882 Engineering Geol. . . . .	2
1.884 Rock Mechanics I . . . . .	2
1.885 Rock Mechanics II . . . . .	2

## THE DOCTOR'S DEGREE

### Environmental Engineering Full-Time Program

The following material outlines the procedures for admission to the doctoral program in environmental engineering and the steps necessary to qualify for the Ph.D. degree. For further information applicants should write to the Chairman of the Ph.D. Committee, Department of Civil Engineering.

### Admission

Each student admitted to the program will initially have the status of doctoral student. In the usual case, he will have received a master's degree in an appropriate field of engineering or science prior to entry into the program. Applicants should apply to the Chairman of the Ph.D. Committee, Department of Civil Engineering for admission to the doctoral program, preferably by February 1st. The committee will interview the applicant, examine his record, and decide whether he should be admitted to the program. The chairman of the department will appoint a program adviser for each doctoral student, upon the recommendation of the Ph.D. Committee.

### Residence Requirement

The residence requirement is satisfied by one year of full-time graduate work after admission as a doctoral student. However, it is expected that at least two years of full-time graduate study will be required beyond the master's degree.

### **Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations. At least one year of full-time study and successful completion of the qualifying examination are required for consideration as a doctoral degree candidate.

### **Qualifying Examination**

The qualifying examination will consist of a written and an oral section. The written part will cover: (1) environmental engineering and/or science and (2) selected areas depending upon the educational background and interest of the student. In certain cases the student may be exempted from the written part of the examination. The oral portion will measure general comprehension. If the oral examination is failed, it may be repeated with permission of the departmental graduate committee. The qualifying examination shall be completed no later than two years after admittance as a doctoral student.

### **Comprehensive Examination**

The comprehensive examination is given after the thesis has been completed. This examination is based upon the defense of the thesis.

### **Course Requirements**

Course requirements for each applicant will be determined by the Ph.D. Committee. Formal course work will be selected to meet the individual student's objectives. Graduate level study up to 12 quarter hours of course work, completed under programs other than this full-time program may be accepted, but requires approval of the committee.

### **Thesis**

After degree candidacy has been established, a candidate must complete a thesis which embodies the results of extended research and includes material suitable for publication.

A thesis committee will be appointed by the chairman of the Ph.D. Committee. The thesis committee, consisting ordinarily of five members, two of whom are from other departments, will be informed of the progress of the thesis and will be responsible for its approval.

### **Language Requirement**

A reading knowledge of one foreign language is required. The requirement shall be determined in a manner prescribed by the committee, and must be satisfied prior to taking the oral qualifying examination.

# mechanical engineering

The Department of Mechanical Engineering offers the degrees of Master of Science in Mechanical Engineering, Mechanical Engineer, and Doctor of Philosophy. The Master of Science degree can be pursued on either a full-time or a part-time basis. A full-time student may apply for participation in the Cooperative Plan. The Mechanical Engineer and Doctor of Philosophy degrees are pursued on a basis consistent with the residence requirements for the degree. The curriculum offers areas of concentration in Mechanics, Thermofluid Engineering, and Materials Science and Engineering.

## THE MASTER OF SCIENCE DEGREE

### Admission

To be enrolled for graduate work leading to the degree of Master of Science in Mechanical Engineering, applicants must have obtained from a recognized college or university the degree of Bachelor of Science in Mechanical Engineering, or a closely-allied engineering field, with an acceptable quality of undergraduate work. Applicants with a Bachelor of Science degree in other engineering or related science fields and an appropriate background of preparation may pursue this program and qualify for the degree of Master of Science without specification.

### Area of Concentration

Each student must complete the required courses in one area of concentration to be eligible to receive the degree. It is expected that these courses will be completed as early as possible in his academic program. The elective courses in each area of concentration should be chosen with the aid of the student's advisor.

### Required Courses

Mechanics		Credits
2.826	Math. Methods for Mech. Eng. I	2
2.827	Math. Methods for Mech. Eng. II	2
2.804	Theory of Elasticity	2
	and	
2.805	Theory of Elasticity	2
	or	

2.819	Fluid Dynamics I	2
	and	
2.820	Fluid Dynamics II	2
2.841	Vibration Theory	2
	and	
2.842	Vibration Theory	2
	or	
2.849	Automatic Cont. Eng.	2
	and	
2.850	Automatic Cont. Eng.	2
	and	
2.851	Automatic Cont. Eng.	2
		<u>12 or 14</u>

**Thermofluid Engineering****Credits**

2.826	Math. Methods for Mech. Eng. I	2
2.827	Math. Methods for Mech. Eng. II	2
2.819	Fluid Dynamics I	2
2.820	Fluid Dynamics II	2
2.901	Adv. Thermodynamics	2
2.902	Adv. Thermodynamics	2
2.910	Conduction Heat Trans.	2
2.911	Convection Heat Trans.	2
		<u>16</u>

**Materials Science and Engineering****Credits**

2.826	Math. Methods for Mech. Eng. I	2
2.827	Math. Methods for Mech. Eng. II	2
2.954	Adv. Physical Met. I	2
2.956	Adv. Physical Met. II	2
2.970	Mat. Sci. and Eng.	2
2.971	Mat. Sci. and Eng.	2
2.804	Theory of Elasticity	2
	or	
2.960	Thermo. of Materials	2
	and	
2.961	Thermo. of Materials	2
		<u>14 or 16</u>

In addition, Seminar (2.990 and 2.998) and Thesis (2.991) are required for continuous full-time and cooperative plan students in all areas of concentration.

**Electives**

Students must take sufficient mechanical engineering departmental electives so that the required courses in their major area and the departmental

Electives total at least 30 of the 40 quarter hours required for the degree.

The remaining ten credits may be elected from any courses in engineering or science for which the student has the necessary preparation.

### Full-Time Program on the Cooperative Plan

The full-time program may be taken on the Cooperative Plan, where students enroll for academic work in the Fall and Winter Quarters of the first year and in the Fall and Winter Quarters of the second year. The other quarters of the two academic years and the summer after the first year are available for professional employment. Students who are admitted to a Master's degree program under the Cooperative Plan must complete, through satisfactory performance, each cooperative work assignment in order to be eligible for the degree.

A thesis of ten quarter hours of credit is required.

For each of the areas of concentration, the sequence of courses on the Cooperative Plan are taken according to the following programs:

#### Mechanics

##### First Academic Quarter Credits

2.826	Math. Methods for Mech. Eng. I	2
2.804	Theory of Elast.	2
	or	
2.819	Fluid Dynamics I	2
2.841	Vibration Theory	2
	or	
2.849	Automatic Cont. Eng.	2
	Electives	<u>4</u>
		10

##### Second Academic Quarter Credits

2.827	Math. Methods for Mech. Eng. II	2
2.805	Theory of Elast.	2
	or	
2.820	Fluid Dynamics II	2
2.842	Vibration Theory	2
	or	
2.850	Automatic Cont. Eng.	2
	Electives	<u>4</u>
		10

##### Third Academic Quarter Credits

2.990	Seminar	1
2.991	Thesis	5
	Electives	<u>4</u>
		10

**Fourth Academic Quarter****Credits**

2.998	Seminar	1
2.991	Thesis	5
	Electives	<u>4</u>
		10

**Thermofluid Engineering****First Academic Quarter****Credits**

2.819	Fluid Dynamics I	2
2.826	Math. Methods for Mech. Eng. I	2
2.901	Advanced Thermodynamics	2
2.910	Conduction Heat Transfer	2
	Elective	<u>2</u>
		10

**Second Academic Quarter****Credits**

2.820	Fluid Dynamics II	2
2.827	Math. Methods for Mech. Eng. II	2
2.902	Advanced Thermodynamics	2
2.911	Convection Heat Transfer	2
	Elective	<u>2</u>
		10

**Third Academic Quarter****Credits**

2.990	Seminar I	1
2.991	Thesis	5
	Electives	<u>4</u>
		10

**Fourth Academic Quarter****Credits**

2.998	Seminar II	1
2.991	Thesis	5
	Electives	<u>4</u>
		10

**Materials Science and Engineering****First Academic Quarter****Credits**

2.804	Theory of Elast.	2
	or	
2.960	Thermodynamics of Materials	2

2.970	Material Science & Engineering	2
	or	
2.954	Advanced Physical Metallurgy I	2
2.826	Math. Methods for Mech. Eng. I	2
	Electives	<u>4</u>
		10

**Second Academic Quarter****Credits**

	Elective	2
	or	
2.961	Thermodynamics of Materials	2
2.971	Material Science & Engineering	2
	or	
2.956	Advanced Physical Metallurgy II	2
2.827	Math. Methods for Mech. Eng. II	2
	Electives	<u>4</u>
		10

**Third Academic Quarter****Credits**

2.954	Advanced Physical Metallurgy I	2
	or	
2.970	Material Science & Engineering	2
2.990	Seminar	1
2.991	Thesis	5
	Elective	<u>2</u>
		10

**Fourth Academic Quarter****Credits**

2.956	Advanced Physical Metallurgy II	2
	or	
2.971	Material Science & Engineering	2
2.998	Seminar	1
2.991	Thesis	5
	Elective	<u>2</u>
		10

**Continuous Full-Time Program**

Students may take the 40 quarter hours of academic work on a continuous full-time basis and complete the degree requirements in one academic year. The sequence of courses which students take on this plan is established by their advisor.

### Part-Time Program

The admission requirements for the evening part-time program are the same as for the full-time program, but students may progress according to their abilities and the time available.

### Advisors for Part-Time Programs

The following faculty members in each area of concentration should be contacted if information is required relative to any academic problems.

Mechanics . . . . .	Professor John N. Rossettos
Thermofluid Engineering . . . . .	Professor Warren G. Nelson
Materials Science and Engineering . . . . .	Professor Richard J. Murphy

### THE MECHANICAL ENGINEER DEGREE

The degree of Mechanical Engineer is offered for those who wish to undertake graduate study beyond the Master's degree without committing themselves to a program as extensive as that required for the Doctor's degree. The degree permits a candidate to pursue a course of study at the upper graduate level in more than one area of Mechanical Engineering as distinguished from the specialization usually associated with the doctoral program.

The following material outlines the requirements for the Mechanical Engineer degree. For further information applicants should write to the Chairman of the Graduate Committee, Department of Mechanical Engineering, Northeastern University, Boston, Massachusetts 02115.

### Admission

To be admitted to candidacy for the degree of Mechanical Engineer, the applicant will have obtained the degree of Master of Science in Mechanical Engineering, or its equivalent, from a recognized institution. In some cases, where the Master's degree is not in Mechanical Engineering, the applicant may be admitted to the program on a conditional basis with the stipulation that certain deficiencies be removed without credit toward the degree. Such special admission is dependent upon the approval of the Mechanical Engineering Graduate Committee.

In general, an applicant will choose two areas of concentration to give him the broad background which characterizes the degree of Mechanical Engineer. An outline of his program must be submitted to the Graduate Committee for approval before final action can be taken upon his application. It is recommended that the applicant discuss his program with the Graduate Committee and members of the graduate faculty in his areas of concentration prior to submission of his program for approval.

Each applicant must submit to the Graduate Committee prior to March 1: (1) transcripts of his undergraduate and graduate records, (2) three letters of recommendation which indicate his ability to carry out advanced graduate work, and (3) the program of study which he proposes to follow.



**Classification and Degree Candidacy**

A student admitted to the Mechanical Engineer degree program will be designated as a Candidate for this degree. The Candidate's advisor normally will be the faculty member who will supervise the dissertation.

**Residence Requirement**

The residence requirement is satisfied by two academic quarters of full-time graduate work during the academic year or by four academic quarters of half-time graduate work during two consecutive academic years. Plans for satisfying the residence requirement on a half-time basis must be approved by the Graduate Committee.

**Qualification and Examinations**

A student must maintain a "B" average to qualify for the degree. Students admitted on a conditional basis may be required to pass special examinations. The Graduate Committee will determine the need for and will administer any such special examinations. A final oral examination consisting of a defense of the dissertation may be required if the Candidate's advisor and the Departmental Graduate Committee so decide.

**Credit Requirements**

A minimum of 40 quarter hours of credit beyond the Master's degree is required. Up to 10 quarter hours of credit will be permitted for work on a dissertation. A minimum of 20 quarter hours of credit must be in the Mechanical Engineering Department.

**Dissertation**

To be awarded the Mechanical Engineer degree, each candidate must complete a dissertation demonstrating a high level of competence in research, development, or design in the field of Mechanical Engineering. The effort normally expected will be the equivalent of 10 quarter hours of graduate course work.

**Transfer Credits**

Any transfer of credits must be approved by the Mechanical Engineering Graduate Committee.

**Time Limitation**

After admission to the program, a maximum of five years will be permitted for completion.

## **Registration**

After approval of the Candidate's program, registration must be continuous. Withdrawal or changes in the program must be approved by the Graduate Committee.

## **THE DOCTOR OF PHILOSOPHY DEGREE**

The degree of Doctor of Philosophy is awarded to those candidates who demonstrate high attainment and research ability in the field of Mechanical Engineering.

The following material outlines the requirements for the Doctor of Philosophy degree. For further information applicants should write to the Chairman of the Department of Mechanical Engineering, Northeastern University, Boston, Massachusetts 02115

## **Admission**

The program leading to the Ph.D. degree is open to persons who are candidates for the Master of Science in Mechanical Engineering degree as well as those who have received the degree. Requests for admission to the program should be made to the Chairman of the Department of Mechanical Engineering. Applicants will receive an application for interview form. This form, along with transcripts of all undergraduate and graduate work and three letters of recommendation, must be returned to the Chairman of the Graduate Committee of the Department of Mechanical Engineering by November 1. The applicant will be notified of an interview time. Based upon an evaluation of the applicant's qualifications, the Graduate Committee will inform the applicant whether or not he will be admitted to the program.

## **Residence Requirement**

The residence requirement is satisfied by one year of full-time graduate work or by two years of half-time graduate work beyond the Master's degree. However, a student should expect to spend at least two years, or the equivalent, in full-time graduate study beyond the requirements of the Master's degree.

## **Degree Candidacy**

After 40 quarter hours of graduate work have been taken with satisfactory grades and upon successful completion of the qualifying examination, a student is established as a degree Candidate.

## **Qualifying Examination**

The qualifying examination in the Department of Mechanical Engineering is offered yearly in January and is both written and oral. The written portion of the qualifying examination is six hours in length and covers, with equal emphasis, four different areas. A student must select one area from each of

he three groups A, B, and C, plus another area either listed below or unlisted, but considered equivalent and approved by the Graduate Committee.

- A. Concepts of Thermodynamics**  
Applied Thermodynamics
- B. Dynamics**  
Mechanics of Deformable Bodies
- C. Heat and Mass Transfer**  
Fluid Mechanics  
Mechanical Behavior of Materials  
Physical Metallurgy

The oral portion of the qualifying examination is conducted by a committee consisting of at least four members appointed by the Graduate Committee. A typical committee is composed of two members specializing in the student's major area plus one member from each of two other areas.

The qualifying examination may be taken by a graduate student who expects to complete the requirements for his Master's degree within three months of the date of the qualifying examination as well as by a person who has already completed the requirements for the Master's degree. Because degree candidacy must be established before the Graduate Committee will act to approve course programs or dissertation proposals, the qualifying examination should be taken at the earliest opportunity. If the examination is failed, it may be repeated with permission of the departmental Graduate Committee.

### **Course Requirements**

To receive the Ph.D. degree a candidate must complete a program of course work approved by the Graduate Committee. Courses completed prior to admittance to the doctoral program are subject to the approval of the Graduate Committee. Each program must contain at least twelve quarter hours of course work, preferably outside of the department, in an area other than that in which the candidate is concentrating. Attainment of a B average for the courses in the "minor" portion of the program will signify satisfactory completion of that portion.

### **Dissertation**

After degree candidacy has been established, a candidate must complete a dissertation which embodies the results of extended research and includes materials suitable for publication.

The departmental Graduate Committee may require the completion of certain course work before permitting dissertation work to commence. A Dissertation Committee will be appointed by the Chairman of the depart-

ment upon the recommendation of the departmental Graduate Committee. The Dissertation Committee will be kept informed of the work and will be responsible for initial approval of the dissertation in its final form.

### **Language Requirement**

A reading knowledge of one foreign language is required. Proficiency in a language shall be determined in a manner prescribed by the departmental Graduate Committee. The language requirement must be fulfilled within six months after the dissertation proposal has been accepted but no less than six months before the degree is granted.

### **Comprehensive Examination**

The comprehensive examination is combined with the final oral examination and is given after the dissertation has been completed and approved. This examination is based upon the subject matter of the dissertation and a defense of it.

### **Final Oral Examination**

The final oral examination is taken after completion of all other requirements for the degree. This examination cannot be held until two weeks have elapsed after the dissertation has been registered and accepted by the Graduate School and must be passed at least two weeks before the commencement at which the degree is to be awarded.

The final oral examination will include the subject matter of the doctoral dissertation and significant developments in the field of the dissertation work. Other fields may be included if recommended by the examining committee.

# electrical engineering

## Admission

To be enrolled for graduate work leading to the degree of Master of Science in Electrical Engineering, applicants must have obtained a Bachelor of Science degree in Electrical Engineering, with an acceptable quality of undergraduate work, from a recognized college or university. Applicants with a Bachelor of Science degree in other engineering or related science fields and an appropriate background of preparation may pursue this program and qualify for the degree of Master of Science without specification. In some cases, students whose Bachelor of Science degree is in some other engineering or related science field may qualify for the degree of Master of Science in Electrical Engineering. This requires special approval of the Department of Electrical Engineering.

## THE MASTER'S DEGREE

### Full-Time Program on the Cooperative Plan

Forty quarter hours of academic work are required. This program may be taken on the Cooperative Plan. On this plan one group of students takes academic work in the Fall and Spring Quarters of the first year and in the Winter Quarter of the second year. Another group may take the academic work in the Winter Quarter of the first year and in the Fall and Spring Quarters of the second year. In either case, the other three quarters of the two academic years and the summer after the first year are available for professional employment. Students who are admitted to a master's degree program under the Cooperative Plan must complete, through satisfactory performance, each cooperative work assignment in order to be eligible for their degree.

The sequence of courses on the Cooperative Plan will normally be taken according to the following pattern:

First Academic Quarter		Credits
3.827	Linear Systems Analysis . . . . .	4
3.842	Linear Active Circuits . . . . .	4
3.823	Mathematical Methods in Electrical Engineering . . . . .	4
	Electives . . . . .	<u>2 or 4</u>
		14 or 16

**Second Academic Quarter****Credits**

3.832	Network Synthesis I	4
3.990	Seminar I	2
3.902	Appl. Prob. & Stoch. Proc.	4
	Electives	<u>4 or 6</u>
		14 or 16

**Third Academic Quarter****Credits**

3.877	Electromagnetic Theory	4
3.991	Seminar II	2
	Electives	<u>8 or 10</u>
		14 or 16

A limited amount of work may be elected from the part-time program.

A thesis for six quarter hours credit is elective with the approval of the chairman of the department. If the thesis option is approved, this work is done in the second year of the program. Details concerning thesis proposals, editorial format, and time schedules are available in the Graduate School Office.

The program of each student will be made up from the required and elective courses available in each term and approved by the student's academic adviser.

**Electives**

The electives will normally be available according to the following schedule:

**Fall Quarter**

- 3.902 Applied Probability and Stochastic Processes
- 3.959 Control Theory I — Analysis and Synthesis
- 3.979 Electronic Digital Computers
- 3.8T0 Numerical Methods and Computer Applications

**Winter Quarter**

- 3.902 Applied Probability and Stochastic Processes
- 3.909 Detection and Estimation Theory
- 3.962 Control Theory II — Nonlinear and Sampled-Data Systems
- 3.966 Switching Circuits
- 3.979 Electronic Digital Computers

**Spring Quarter**

- 3.8T9 Digital Filtering
- 3.902 Applied Probability and Stochastic Processes
- 3.905 Information Theory and Coding
- 3.954 Systems Analysis
- 3.965 Control Theory III — Optimal Control and Stochastic Systems

(Additional electives will be available from the late afternoon portion of the part-time program in all quarters.)

**Full-Time Program**

For those students whose programs would be better served by full-time study the prescribed courses may be taken in one academic year. The sequence of the required courses will be different from the full-time program on the Cooperative Plan.

**POWER SYSTEMS MAJOR****Full-Time Program on the Cooperative Plan**

The course requirements vary with the student's background, but generally can be computed on the basis of the minimum of 40 quarter hours of course work.

For students enrolled in Northeastern's Power Systems Program at the undergraduate level, it is possible (and customary) to take 6 q.h. of credit toward the M.S. in the last quarter of their senior year. Normally these courses are 3.900 Applied Probability and Stochastic Processes A, 2 q.h. and 2.237 Nuclear Engineering II, 4 q.h. although other options (e.g. 3.959 Control Systems I, 3.295 Numerical Methods and Computer Applications) are acceptable. This permits a student to accept a co-op assignment during the summer and fall and then to complete the M.S. requirements with full-time study during the winter and spring quarters. Such a student would take the following program.

**Winter Quarter****Credits**

3.827	Linear Systems Analysis	4
3.926	Power Circuit Analysis II	2
3.936	Computers in Power Systems II	2
3.941	Electric Machinery Theory II	2
*3.292	Mathematical Techniques in Electrical Engineering I	4
	Electives	2-4
		<b>16-18</b>

\* An acceptable alternative to 3.292 is the equivalent 3.8C1 and 3.8C2 offered in the evening.

<b>Spring Quarter</b>		<b>Credits</b>
3.877	Electromagnetic Theory .....	4
3.927	Power Circuit Analysis III .....	2
3.937	Computers in Power Systems III .....	2
3.931	Power System Planning .....	4
	Electives .....	4-6
		<b>16-18</b>

Total Must Equal 34 Credits

Students coming from other institutions, who wish to enroll in the co-operative plan will attend classes during the Fall and Winter of the first year, go out on a cooperative work assignment for the Spring and Summer, and return to finish their studies in the Fall of their second year. A specimen program follows.

<b>Fall Quarter</b>		<b>Credits</b>
3.827	Linear Systems Analysis .....	4
3.925	Power Systems Analyses I .....	2
3.935	Computers in Power Systems I .....	2
3.823	Mathematical Methods in E. E. ....	4
3.940	Electric Machinery Theory I .....	2

<b>Winter Quarter</b>		<b>Credits</b>
3.926	Power Systems Analysis II .....	2
3.877	Electromagnetic Field Theory .....	4
3.936	Computers in Power Systems II .....	2
3.941	Elective Machine Theory II .....	2
3.990	Seminar .....	2
3.933	Power System Transients .....	2

<b>Fall Quarter</b>		<b>Credits</b>
3.932	Power System Protection .....	2
3.945	Power System Transient Stability .....	2
2.236	Nuclear Engineering I .....	4
3.959	Control Theory I .....	4
3.991	Seminar .....	2

For electives, all power students should consider selections from the power systems courses listed on page 72. Other suitable graduate courses are possible with the approval of the Director of the Power Systems Evening Program.

### Continuous Full-Time Program

For those students whose plans would be better suited by continuous



full-time study the prescribed courses may be taken in one academic year. The courses required in the spring quarter will be somewhat different from the specimen programs shown above.

### **Part-Time Program Power Systems Major**

Forty quarter hours of academic work are required for the master's degree of which 26 quarter hours of credit are specified as follows:

<b>Required Courses</b>	<b>Credits</b>
3.825 Linear Systems Analysis II .....	2
3.826 Linear Systems Analysis III .....	2
3.875 Electromagnetic Theory I .....	2
3.876 Electromagnetic Theory II .....	2
3.900 Applied Probability and Stochastic Processes A .....	2
3.8C1 Mathematical Methods in Electrical Engineering I .....	2
3.8C2 Mathematical Methods in Electrical Engineering II .....	2
3.926 Power Circuit Analysis II .....	2
3.927 Power Circuit Analysis III .....	2
3.936 Computers in Power Systems II .....	2
3.937 Computers in Power Systems III .....	2
3.941 Electric Machinery Theory II .....	2
3.930 Power System Planning .....	2

In addition to the specified course work, each student must complete 10 of the remaining 14 quarter hours from the Power System Electives listed on page 72.

### **Part-Time Program Electrical Engineering**

#### **Admission**

The admission requirements for the part-time program leading to the degree of Master of Science in Electrical Engineering are the same as for the full-time program, but students may progress according to their abilities and the time available.

All graduate courses presuppose mastery of the subject matter of a modern, fully accredited curriculum in electrical engineering. Applicants who have not taken further academic work for some time since they received their bachelor's degree may be required to take graduate courses to satisfy any deficiencies. For this purpose, the following courses are available:

	<b>Credits</b>
3.975    Precs of Modern Electrical Engineering I .....	2
3.976    Precs of Modern Electrical Engineering II .....	2
3.977    Precs of Modern Electrical Engineering III .....	2
3.978    Precs of Modern Electrical Engineering IV .....	2

These courses carry graduate credit but a maximum of four quarter hours of credit from this group may be used as elective credit in the degree program.

### **Program**

Forty quarter hours of academic work are required for the master's degree of which 16 quarter hours of credit are specified as follows:

<b>Required Courses</b>	<b>Credits</b>
3.825    Linear Systems Analysis II .....	2
3.826    Linear Systems Analysis III .....	2
3.840    Linear Active Circuits I .....	2
3.841    Linear Active Circuits II .....	2
3.875    Electromagnetic Theory I .....	2
3.876    Electromagnetic Theory II .....	2
3.8C1    Mathematical Methods in Electrical Engineering I .....	2
and	
3.8C2    Mathematical Methods in Electrical Engineering II .....	2
or	
3.8C4    Mathematical Methods in Electrical Engineering III .....	2
and	
3.8C5    Mathematical Methods in Electrical Engineering IV .....	2
or	
3.900    Applied Probability and Stochastic Processes I .....	2
and	
3.901    Applied Probability and Stochastic Processes II .....	2

Students lacking the necessary prerequisites for 3.8C1 or 3.8C4 may be required to take undergraduate courses 3.292 or 3.293 to clear this deficiency. By petition, these courses may carry graduate credit.

### **Electives**

In addition to the required course work each student is expected to select a major and a minor area from the list given below. Ten quarter hours of credit must be taken in the major area and six quarter hours of credit taken in the minor area. The area or areas to which a course is assigned is indicated in the following listings. Not every course is assigned to an area. They may be used as one of the free elective courses. Eight quarter hours of credit are free electives which may be selected from graduate courses in

sciences or other engineering departments for which the student has the necessary preparation.

### Subject Areas

#### 1. Circuits and Systems

3.830	3.838	3.911
3.831	3.839	3.912
3.832	3.843	3.950
3.833	3.845	3.951
3.834	3.860	3.952
3.835	3.861	3.953
3.837	3.910	3.954

#### 2. Computer Science

3.837	3.935
3.860	3.936
3.861	3.937
3.893	3.966
3.894	3.967
3.895	3.968
3.898	3.969
3.899	3.972
3.8A1	3.973
3.8T1	3.974
3.8T0	3.979
3.8T2	3.985
3.8T3	3.986
3.8T7	3.987
3.8T8	3.988
3.8T9	3.989

#### 4. Communications and Control

3.817	3.907
3.818	3.908
3.819	3.909
3.865	3.9C1
3.866	3.9C2
3.867	3.957
3.871	3.958
3.872	3.959
3.873	3.960
3.898	3.961
3.899	3.962
3.900	3.963
3.901	3.964
3.902	3.965
3.903	3.9A1
3.905	3.9A2
3.906	

#### 3. Fields, Waves and Optics

3.800	3.879	3.918
3.801	3.880	3.919
3.802	3.881	3.920
3.806	3.882	3.921
3.807	3.883	3.922
3.808	3.885	3.923
3.810	3.890	3.924
3.811	3.891	3.980
3.812	3.913	3.981
3.817	3.914	3.982
3.818	3.915	3.983
3.819	3.916	3.984
3.878	3.917	

#### 5. Physical Electronics

3.806	3.854
3.807	3.8G1
3.808	3.8G2
3.853	3.8G3

**6. Power Systems**

2.905	2.936	3.927	3.940
2.906	2.938	3.928	3.941
2.907	2.942	3.930	3.942
2.920	2.943	3.931	3.943
2.921	2.944	3.932	3.944
2.931	3.810	3.933	3.945
2.932	3.811	3.935	3.955
2.933	3.812	3.936	3.956
2.934	3.925	3.937	
2.935	3.926	3.938	

**Quarter-Sequence Courses**

Certain courses have an A or B after the course title. In these cases, credit will be given toward the degree only if both the A and B courses are successfully completed.

**ELECTRO-OPTICS PROGRAM**

The Electro-Optics Program is designed to provide the engineer and scientist with a working knowledge of current electro-optical techniques and systems. Emphasis is placed on application to industrial and research problems.

**Admission**

To be enrolled for this degree program, applicants must have a Bachelor of Science degree in Electrical Engineering or Physics, with an acceptable quality of undergraduate work from a recognized institution. Admission requirements are those of the regular program in electrical engineering.

**Program**

Forty quarter hours of academic work are required, of which 18 are specified. At least 12 additional hours of electives in optics are to be chosen from the optics elective listed below. The remaining ten hours may be selected from optics electives or from suitable courses in science or engineering.

<b>Specified Courses</b>		<b>Credits</b>
3.8C1	Math. Methods in Elec. Eng. I . . . . . and	2
3.8C2	Math. Methods in Elec. Eng. II . . . . . or	2
3.8C4	Math. Methods in Elec. Eng. III . . . . . or	2
3.8C5	Math. Methods in Elec. Eng. IV . . . . .	2

3.914	Electro-Optics I	2
3.915	Electro-Optics II	2
3.916	Fourier-Optics I	2
3.917	Fourier-Optics II	2
3.918	Experimental Optics I	2
3.919	Experimental Optics II	2
3.920	Experimental Optics III	2

**Optics Electives****Credits**

3.806	Lasers I	2
3.807	Lasers II	2
3.808	Laser Applications	2
3.913	Optical Storage and Display	2
3.921	Optical Properties of Matter I	2
3.922	Optical Properties of Matter II	2
3.923	Optical Properties of Matter III	2
3.924	Advanced Topics in Electro-Optics	2
3.980	Optical Instrument Design Concepts	2
3.981	Principles of Optical Detection I	2
3.982	Principles of Optical Detection II	2
3.983	Fourier Optics III	2
3.984	Spectroscopic Instrumentation	2

**MODEL PROGRAM IN ELECTRO-OPTICS****First Year****Credits**

3.8C4	Math. Meth. in Elec. Eng. III	2
3.8C5	Math. Meth. in Elec. Eng. IV	2
3.914	Electro-Optics I	2
3.806	Lasers I	2
3.807	Lasers II	2
3.808	Laser Applications	<u>2</u>
		12

**Second Year****Credits**

3.915	Electro-Optics II	2
3.916	Fourier Optics I	2
3.917	Fourier Optics II	2
3.918	Experimental Optics I	2
3.919	Experimental Optics II	2
3.920	Experimental Optics III	<u>2</u>
		12

**Third Year****Credits**

3.913	Optical Storage and Display	2
3.921	Optical Properties of Matter I	2
3.922	Optical Properties of Matter II	2
3.981	Prin. Optical Det. I	2
3.982	Prin. Optical Det. II	2
3.984	Spectroscopic Instr.	<u>2</u>
		12

Four additional hours of electives are required for a total of 40 credits for the degree.

**Course Prerequisites**

The prerequisites suggested for each course are given so that the student will receive full benefit from the course. In case of doubt, the student should consult the Director of the Electro-Optics Program or the course instructor.

**COMPUTER SCIENCE MAJOR**

The Computer Science Program is structured to provide a curriculum of study in computer science and engineering leading to the degree of Master of Science in Electrical Engineering, or Master of Science, with a major in Computer Science.

**Admission**

To be enrolled for this degree program, applicants must have obtained a Bachelor of Science degree in engineering, mathematics, or the physical sciences from a recognized college or university and must present satisfactory evidence of ability to pursue graduate study.

**Program**

Forty quarter hours of academic work are required, of which 14 are specified and 26 are elective.

**Specified Courses****Credits**

3.893	Digital Computer Programming I	2
3.894	Digital Computer Programming II	2
3.972	Electronic Digital Computers I	2
3.973	Electronic Digital Computers II	2
3.8A1	Mathematical Methods in Computer Science	2
3.8T1	Numerical Methods and Computer Applications I	2
3.8T2	Numerical Methods and Computer Applications II	2

**Electives**

Sixteen quarter hours of credit must be chosen from the following list of courses. It is urged that students take both of the courses in any two-quarter sequence they elect, and at least two courses in any three-quarter sequence they elect.

- 3.837 Introduction to Graph Theory
- 3.895 Digital Computer Programming III
- 3.898 Combinatorial & Optimization Techniques I
- 3.899 Combinatorial & Optimization Techniques II
- 3.8T3 Numerical Methods and Computer Applications III
- 3.8T7 Digital Filtering I
- 3.8T8 Digital Filtering II
- 3.904 Error Correcting Coding
- 3.908 Special Topics in Communication Theory
- 3.966 Switching Circuits
- 3.967 Switching Circuits I
- 3.968 Switching Circuits II
- 3.969 Switching Circuits III
- 3.974 Electronic Digital Computers III
- 3.985 Fundamentals of Automatic Digital Computation I
- 3.986 Fundamentals of Automatic Digital Computation II
- 3.987 Fundamentals of Automatic Digital Computation III
- 3.988 Special Topics in Computer Science
- 3.989 Computer Peripherals
- 3.995 Thesis
- 3.998 Special Problems in Electrical Engineering
- 5.911 Linear Programming
- 5.916 Engineering Analysis Utilizing Data Processing
- 5.941 Management Information Systems

Students must take sufficient electrical engineering departmental courses to total 30 of the 40 quarter hours required for the degree.

**Thesis**

A thesis carrying six credits may be elected with the approval of the chairman of the department. If the thesis option is approved, this work is done in the second half of the program.

**THE DOCTOR'S DEGREE****Full-Time Program**

The following material outlines the procedures for admission to the doctoral program and the steps necessary to qualify for the Ph.D. degree. For further information applicants should write to the Secretary, Department of Electrical Engineering.

**Admission**

Students who are interested in pursuing a doctor's program, should contact the Electrical Engineering Department to request an application. Completed applications, together with transcripts of all prior work and two letters of recommendation, should be forwarded to the Electrical Engineering Department, 412 Dana Hall, no later than December 1 of the preceding year. Following evaluation of this material, the applicant will be informed whether or not he will be permitted to undertake the qualifying examination. A personal interview is not required, but a student may arrange with the Secretary of the Electrical Engineering Graduate Committee, Professor Robert N. Martin (617-437-3041), for an appointment for further program details if desired. A student who has received approval to take the qualifying examination is considered a pre-doctoral student until such time as he passes the examination. Upon successful completion of the qualifying examination he becomes a Ph.D. candidate.

**Residence Requirement**

The residence requirement is satisfied by one year of full-time graduate work or two consecutive years of part-time graduate work. In the latter case, a detailed time schedule must be approved by the student's adviser in order to give evidence that a least half of the time is being devoted to the requirements of the graduate school program.

**Qualifying Examination**

The Ph.D. qualifying examination has emerged from its role as a requirement for admission to the doctoral program to the dual purpose of, one: serving as an indicator of the student's capability for successful completion of the program, and two: serving as a guide to his adviser in developing a suitable plan of study tailored to the individual needs of the candidate.

With these goals in mind, the candidate is urged to take the qualifying examination early in his graduate program (i.e., not later than the successful completion of 40 quarter hours of graduate work).

The examination is composed of a written and an oral part, and is usually given in the spring quarter of each academic year. The written part covers the following general categories:

- (1) Circuits and Electronics
- (2) Fields, Waves, and Energy Conversion
- (3) Systems
- (4) Miscellaneous Topics in Electrical Engineering

For candidates pursuing a Ph.D. with an emphasis in either Computer Science or Modern Optics, the qualifying examination will be appropriately modified.

The oral part is designed to test general comprehension. Together, the oral and written portions of the examination review the factual knowledge of



a typical undergraduate Electrical Engineering program and the understanding of that material from a more mature point of view.

If the examination is failed it may be repeated only with permission of the Graduate Committee upon recommendation of the Ph.D. Qualifying Examination Committee.

### **Comprehensive Examination**

Within three years of his establishment of degree candidacy, the student will be required to demonstrate by means of a comprehensive examination a subject matter knowledge satisfactory for the award of the degree.

The comprehensive examination is an oral examination open to the Electrical Engineering faculty (assistant professor and above in rank) and administered by the student's Thesis Committee. Departmental faculty will be informed of the examination via a departmental notice at least one week prior to the examination. Normally the examination will be given at the time the Thesis Proposal is submitted to the Thesis Committee for approval. As part of this examination the Thesis Committee will review the student's doctoral program and his performance in graduate courses, as well as examine the student on subject matter related to his graduate studies and his thesis area.

### **Course Requirements**

Successful completion of a doctoral program normally requires 70 quarter hours of satisfactory graduate level work exclusive of thesis research and doctoral reading courses.

Doctoral Seminar, 3.993 and 3.994 are the only required courses.

The course work must include a three-course sequence (graduate level) in each of two minor areas. Both minors must be in science, applied science, or a related area. One minor may be chosen from an area of electrical engineering outside the candidate's proposed major area.

### **Thesis**

The candidate's thesis research shall be directed by his Thesis Adviser, whom he shall select upon establishing candidacy. The Thesis Committee shall approve the thesis in final form.

### **Language Requirement**

The language requirement may be satisfied in French, German, or Russian. The Princeton Educational Testing Service Language Examination is used for this purpose. The examination is administered by Northeastern University annually. If necessary, it may be taken at another institution. It must be passed before the final oral examination is taken.

### **Final Oral Examination**

This examination will be held in accordance with the departmental regulations.

## **THE ELECTRICAL ENGINEER DEGREE**

The Department of Electrical Engineering offers the graduate professional degree usually known as the Engineer Degree. This degree, offered at a number of institutions, usually requires about one year of full-time graduate study beyond the master's degree. The official title of the degree is "Electrical Engineer".

The following material outlines the procedures for admission to the Electrical Engineer degree program and the steps necessary to qualify for the degree. For further information applicants should write to Professor Robert A. Gonsalves, Department of Electrical Engineering, Room 329, Dana Hall, Northeastern University.

### **Admission**

Students who are interested in pursuing the Electrical Engineer degree should make application for admission to the program prior to April 1. A master's degree in electrical engineering or its equivalent and the approval of the departmental graduate committee is required for admission. In some cases, where the master's degree is not in electrical engineering, a student may be admitted to the program with the stipulation that certain deficiencies be made up without credit toward the degree.

The Engineer Degree is available on either a full-time or part-time basis.

### **Classification and Degree Candidacy**

A student admitted to the Engineer degree program will be designated as a candidate for this degree.

### **Residence Requirement**

A plan for satisfying the residence requirement must be approved by the student's adviser.

### **Qualification and Examinations**

A student must maintain a B average in order to qualify for the degree. In some instances, a student may be required to take special examinations. Such examinations will be determined in each case by the departmental graduate committee.

### **Course Requirements**

The minimum course requirements will be 40 quarter hours beyond the master's degree, with no more than 10 quarter hours of credit out of the 40

allowed for work on the project report. A minimum of 20 quarter hours must be taken in electrical engineering. The student's course program must be approved by his adviser.

### **Project Report**

Each engineer degree student must complete a project report which demonstrates a high level of competence in research, development, or design in the field of electrical engineering. As a general guideline, the amount of effort normally expected will be the equivalent of about 10 quarter hours of graduate work.

### **Language Requirement**

No foreign language is required for the Electrical Engineer degree.

### **Final Oral Examination**

A final oral examination consisting of a defense of the dissertation may be required if the student's adviser and the departmental graduate committee so decide.

### **Transfer of Credits**

Approval for transfer of credit may be given by the departmental graduate committee upon request from the student.

### **Time Limitation**

After admission to the program, a maximum of five years will be allowed for completion of the degree requirements. Extension of this time limit may be granted with the approval of the departmental graduate committee.

### **Registration**

All students must register for course work or dissertation as approved by their advisers or the departmental registration officer. After the first registration for this work, registration must be continuous unless withdrawal is allowed by the departmental committee in charge of the degree program.

# chemical engineering

## Admission

To be enrolled for graduate work in Chemical Engineering, applicants usually have obtained a Bachelor of Science degree in Chemical Engineering, with an acceptable quality of undergraduate work from a recognized college or university. However, qualified students with other B.S. or B.A. degrees in science or engineering may be admitted. Such students are required to complete supplementary undergraduate work in addition to the usual M.S. program in order to qualify for the M.S. degree in Chemical Engineering. Complete programs for these students are worked out after the student has made formal application to the program through the Graduate School of Engineering. The undergraduate work required is strongly dependent on the mathematics, chemistry, and engineering background of the applicant. The undergraduate course work in such programs may not be used for degree credit.

## THE MASTER'S DEGREE

### Full-Time Program on The Cooperative Plan

Forty quarter hours of academic work are required. This program may be taken on the Cooperative Plan where students enroll for academic work in the Fall and Spring Quarters of the first year and in the Winter Quarter of the second year. The other three quarters of the two academic years and the summer after the first year are available for professional employment. Students who are admitted to a master's degree program under the Cooperative Plan must complete, through satisfactory performance, each cooperative work assignment in order to be eligible for their degree.

The sequence of courses on the Cooperative Plan will normally be taken according to the following pattern:

#### First Academic Quarter\*

#### Credits

4.802	Chemical Engineering Mathematics	4
4.829	Chemical Process Control	4
4.891	Kinetics of Chemical Processes	4
4.991	Thesis	<u>2</u>
		14

\* Courses listed in the first academic quarter are required for all M.S. candidates.

**Second Academic Quarter****Credits**

	Chemical Engineering Electives . . . . .	8
4.991	Thesis . . . . .	<u>5</u>
		13

**Third Academic Quarter****Credits**

	Chemical Engineering Electives . . . . .	8
4.991	Thesis . . . . .	<u>5</u>
		13

**Chemical Engineering Electives**

The electives will normally be available according to the following schedule:

**Winter Quarter**

- 4.801 Advanced Chemical Engineering Calculations
- 4.803 Numerical Techniques in Chemical Engineering
- 4.811 Chemical Engineering Thermodynamics
- 4.823 Transport Phenomena
- 4.840 Advanced Management Techniques in the Chemical Industry
- 4.890 Chemical Reactor Analysis
- 4.974 Fluid Mechanics

**Spring Quarter**

- 4.806 Optimization Techniques
- 4.845 Advanced Plant Design Concepts
- 4.850 Chemical Process Pollution Control (Water)
- 4.973 Heat Transfer

Students may take the program on a continuous full-time basis to complete the degree requirements in one academic year. The sequence of courses which students take on this plan is established by the chairman of the department.

All Ph.D. candidates are required to do an M.S. thesis. All M.S. students not doing a thesis are required to take 4.833 Research Techniques I. In addition, D. Eng. candidates are required to take 4.834 Research Techniques II if they are not doing a thesis. If a student is planning to take Research Techniques I, he or she must notify the department at least one full quarter before the quarter in which it is to be taken. This normally means that a student should notify the Chemical Engineering Department before the end of the Fall semester as to when he or she intends to take 4.833.

M.S. Thesis normally carries twelve quarter hours of academic credit. Research Techniques I carries four quarter hours of credit. The remaining eight quarter hours of credit required to complete the degree requirements

may be taken from any courses which have been approved, in advance, by the departmental graduate registration officer.

With the approval of the chairman of the department, substitutions may be made for some of the prescribed courses by other courses in the department or in other departments which give graduate work.

### **PART-TIME PROGRAM**

The admission requirements for this program are the same as for the full-time program, but students may progress according to their ability to combine their study with their employment. Students must take sufficient day and evening chemical engineering courses so that the required courses in their major total at least 30 of the 40 quarter hours required for the degree. The remaining 10 credits may be elected from any approved courses in engineering or science for which the student has the necessary preparation. Required courses and electives for all degree candidates must be approved by the chemical engineering departmental adviser. A maximum of seven years is allowed to complete the program.

Students wishing to switch their status from part-time to full-time M.S. candidates must notify the Chemical Engineering and make formal application with the Graduate School of Engineering. Such requests are usually granted for the full-time program to begin in the Fall Quarter.

### **THE DOCTOR OF PHILOSOPHY DEGREE**

The following material outlines the procedure for admission to the doctoral program and the steps necessary to qualify for the Ph.D. degree. For further information applicants should write to the Chairman of the Department of Chemical Engineering.

#### **Admission**

Applicants who are enrolled as candidates for the degree of Master of Science in Chemical Engineering at Northeastern University should apply in writing to the Chairman of the Department of Chemical Engineering for admission to the doctoral program. Such application must be made by April first of the year in which they expect to receive the master's degree. The departmental graduate committee will examine the record of the applicant and decide whether or not he should be allowed to take the qualifying examination.

Applicants who are enrolled for graduate work at other institutions or who have completed the requirements for the master's degree should write the chairman of the department for an application for an interview. This form, together with transcripts of all undergraduate and graduate work, must be transmitted to the chairman of the departmental graduate committee. The applicant will be notified of an interview time and, after the interview, will be advised if he should make formal application for admission to the doctoral program. Approved applicants must submit an application for

admission as a doctoral candidate and two letters of recommendation not later than April first. The applicant will be notified of the acceptance of his application and the date of the qualifying examination.

### **Residence Requirement**

The residence requirement is satisfied by one year of full-time graduate work or two consecutive years of part-time graduate work. In the latter case, a detailed time schedule must be approved by the departmental graduate committee as evidence that at least half of the time is being devoted to the requirements of the graduate school program. In general, it should be expected that at least two years of full-time work after establishment of degree candidacy will be necessary.

### **Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations.

### **Qualifying Examination**

The qualifying examination includes both written and oral parts and is normally given in the spring and the fall. The written examination, in general, will cover the following areas:

1. General Principles in Chemical Engineering Science
2. Thermodynamics and Stoichiometry
3. Mathematical Procedures and Kinetics
4. Specialized Technological Topics (to be announced)

The oral examination will test general comprehension.

A student may take any or all of the written examinations in each area and may repeat a failed examination, only once, at a later offering. The taking and successful completion of all examinations may not extend over a period greater than 13 months. Previously administered examinations will be available to formal applicants.

### **Comprehensive Examination**

During the time in which a student is a candidate for a doctoral degree he may be required to demonstrate by means of a comprehensive examination a subject-matter knowledge satisfactory for the award of the degree.

### **Course Requirements**

The course requirements in addition to the minimum requirements for establishing degree candidacy will be determined by the departmental graduate committee and the student in consultation with the committee.

Transfer credit will be dealt with on an individual basis by the departmental graduate committee in accordance with the general graduate school regulations.

**Thesis**

An individual may choose his thesis topic and supervisor as soon as he becomes a doctoral student. In most cases selection of topic will be made immediately after the student has established his candidacy for the Ph.D. degree. He will be expected to discuss with the staff their Ph.D. thesis topics offerings. After these discussions, the student shall notify the adviser, the department head, and the chairman of the departmental graduate committee in writing of his choice of thesis topic and adviser. The chairman of the departmental graduate committee after consultation with the thesis adviser shall appoint an appropriate thesis committee. This committee shall be kept informed of the progress of the thesis and will approve the thesis in its final form.

**Language Requirement**

The foreign language requirement may be satisfied by a reading knowledge in two languages selected from French, German, and Russian. The examinations are administered by the department and consist of translation from current scientific journals or textbooks.

**Final Oral Examination**

This examination is held in accordance with the general regulations of the graduate school.

**THE DOCTOR OF ENGINEERING DEGREE**

The following material outlines the procedure for admission to the doctoral program and the steps necessary to qualify for the Doctor of Engineering degree. For further information, applicants should write to the Chairman of the Department of Chemical Engineering.

**Admission**

Applicants for the Doctor of Engineering program must either be candidates for the Master of Science degree in Chemical Engineering or have completed the Master of Science program in Chemical Engineering.

Applicants need not have undertaken a master's thesis.

Applicants for the Doctor of Engineering degree must pass the doctorate qualifying examination given to applicants for the Doctor of Philosophy degree in this department.

Applicants must file application forms with the departmental graduate committee along with official transcripts of previous college work, and two letters of recommendation. Applicants will not be considered until all documents have been received. Applicants will be notified promptly as to whether or not they have been accepted.



**Residence Requirement**

The residence requirement is satisfied only by full-time residence for one academic year. This requirement must be fulfilled after successful completion of the qualifying examination and prior to the end of the five-year period set forth in the general regulations.

**Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations.

**Qualifying Examination**

The qualifying examination includes both written and oral parts and is normally given in the spring and the fall. The written examination, in general, will cover the following areas:

1. General Principles in Chemical Engineering Science
2. Thermodynamics and Stoichiometry
3. Mathematical Procedures and Kinetics
4. Specialized Technological Topics (to be announced)

The oral examination will test general comprehension.

A student may take any or all of the examinations in each area and may repeat a failed examination, only once, at a later offering. The taking and successful completion of all examinations may not extend over a period greater than 13 months. Previously administered examinations will be available to formal applicants.

**Comprehensive Examination**

During the time in which a student is a candidate for a doctoral degree he may be required to demonstrate by means of a comprehensive examination a subject-matter knowledge satisfactory for the award of the degree.

**Course Requirements**

The course requirements, in addition to the minimum requirements for establishing degree candidacy, will be determined by the departmental graduate committee and the student in consultation with the committee.

Transfer credit will be dealt with on an individual basis by the departmental graduate committee in accordance with the general graduate school regulations.

**Engineering Problem**

Engineering Problem advisers will be appointed by the departmental graduate committee. Approval of the topic for the Problem rests with the Problem adviser and the committee.

The Engineering Problem is not a research problem but rather an

engineering problem in depth. It may include elements of design, economics, business management principles, and process development. In general, it will not include laboratory investigations.

Normally, the Engineering Problem will be solved on campus. Under special arrangements approved by the departmental graduate committee and the adviser, a portion of the work may be performed off campus.

Regardless of the arrangements made for the Engineering Problem, no off-campus adviser will be approved. Only the Problem adviser will specify the nature and requirements of the Problem, and the findings and results remain the property of the adviser and the University to be published as they determine.

### **Language Requirement**

There is no foreign language requirement for this degree.

### **Computer Ability**

Ability with computer programming must be demonstrated when required.

### **Final Oral Examination**

This examination is held in accordance with the general graduate school regulations.

# **industrial engineering and engineering management**

The Department of Industrial Engineering offers the following degrees: Master of Science in Industrial Engineering and Master of Science in Engineering Management and Industrial Engineer degree. Degrees can be pursued on a part- or full-time basis and full-time students may elect to participate in the Cooperative Plan. Under the Cooperative Plan a student spends 9-12 months working in a field which is complementary to his academic program and professional goals. During this time he receives compensation from his employer, which is generally in line with salaries for engineers with equivalent experience.

The Master of Science in Industrial Engineering has a General Program as well as majors in Health Systems, Computer and Information Systems, and Operations Research; all of which require a thesis. The Master of Science in Engineering Management has a General Program and majors in Computer and Information Systems and Operations Research. A thesis is not a requirement for this degree. A minimum of 40 quarter hours of graduate level credit is required for either degree program. The Industrial Engineer degree requires 40 quarter hours beyond the M.S. degree. Specific requirements are listed on page 94.

## **Industrial Intern Program Leading to the MSIE**

The Engineering Sponsorship program in Industrial Engineering is known as the Industrial Intern Program. The program, available to a selected group of students, is an enriched MSIE cooperative program in which the student, the University, and a cooperating employer tailor each program to individual interests. Usually the minimum academic requirements of the MSIE program will be substantially surpassed in the industrial intern option.

Through agreements with cooperating employers, students accepted for the industrial intern option will receive full tuition and living expenses for seven or eight quarters. Four of these will be spent in professionally relevant employment. During each of these cooperative quarters, students will take independent study under the direction of a faculty member. Wherever

possible, those specialized reading courses will lead toward a thesis problem statement of interest to the student, cooperative employer and the department. When this goal is achieved, the MSIE program will be completed in seven quarters. A goal of the industrial intern option is that each student's thesis be a significant independent investigation.

### Admission to M.S. Programs

To be enrolled for graduate study in Industrial Engineering or Engineering Management, the applicant must have obtained a Bachelor of Science degree in an engineering field, with an acceptable quality of undergraduate work from a recognized college or university. A limited number of applicants with a Bachelor of Science degree in mathematics or a closely related science, whose preparation is considered adequate, may be permitted to pursue either program, and, upon its completion, qualify for the degree of Master of Science without specification.

Entrance to either program presupposes that students have had a basic course in each of the following areas: engineering economy, probability, engineering statistics, operations research (deterministic and stochastic), computer programming (compiler language), and accounting. Recognizing that some applicants may be deficient in certain of these subjects, the program offers the intensive courses listed below. At the time of admission to the program the adviser will specify, on the basis of the applicant's transcript, those courses on the list which the applicant must complete satisfactorily to qualify for the degree. Such specified courses are to be completed as early in the program as scheduling will permit. The courses below carry graduate credit but a maximum of six quarter hours of credit from this group may be used as elective credit toward the degree.

Course	Credits
5.808 Basic Engineering Economy . . . . .	2
5.810 Industrial Accounting for Engineers . . . . .	2
5.901 Basic Operations Research I (Deterministic) . . . . .	2
5.902 Basic Operations Research II (Stochastic) . . . . .	2
or	
5.900 Operations Research . . . . .	4
Equivalent to 5.901 and 5.902	
5.913 Data Processing for Engineers (FORTRAN) . . . . .	2
*5.960, 61, 62 Prob. of Statistics I, II, III . . . . .	6
	16

\*Note: As of September 1976 these courses supercede 5.950 and 5.951, Statistics I and II. Students enrolled in the program prior to this date who have not satisfied a requirement of 5.950 and 5.951 should see their advisor to work out equivalent courses and credits.

**Industrial Engineering Programs — no specified major****Required Courses**

<b>Course</b>	<b>Credit</b>	<b>Quarter</b>
5.803 Industrial Organizations . . . . .	2	Fall
5.823 Advanced Production Analysis* . . . . .	4	Fall
5.824 Case Studies in Industrial Engineering . . . . .	2	Spring
5.909 System Engineering and Analysis . . . . .	2	Spring
5.914 Advanced O.R. . . . .	4	Spring
5.963 Statistics . . . . .	2	
5.964 Des. of Exp. I . . . . .	2	
5.992 Seminar . . . . .	2	Fall
5.991 Thesis . . . . .	6	All Quarters

The remaining hours are satisfied through a suitable choice of electives at least 6 hours of which will come from one of the five areas of concentration:

Management of Technology  
 Operations Research and Quantitative Techniques  
 Production Engineering and Man/Machine Systems  
 Financial and Operational Controls  
 Computer and Information Systems

**HEALTH SYSTEMS MAJOR**

This major is offered on a two-year cooperative basis. Students are expected to spend at least three academic quarters as an intern or resident in training in a health-oriented organization such as a hospital or health planning agency. In addition, the thesis topic must be related to the field of health.

**Required Courses**

<b>Course</b>	<b>Credit</b>	<b>Quarter</b>
5.823 Advanced Production Analysis* . . . . .	4	Fall
5.860 Health Care Organization and Management. . . . .	2	Fall
5.865 Case Studies in Health Systems . . . . .	2	Spring
5.909 Systems Engineering and Analysis . . . . .	2	Winter
5.914 Advanced O.R. . . . .	4	Spring
5.963 Statistics . . . . .	2	
5.991 Thesis . . . . .	6	All Quarters
5.992 Seminar . . . . .	2	Fall

The remaining hours should be satisfied through appropriate choice of electives.

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\* Not required for students with a degree in Industrial Engineering

**ENGINEERING MANAGEMENT****(No specified major)**

To assure adequate preparation for management of technological activities, all students who do not elect the Computer Systems or Operations Research major must earn the minimum number of credits indicated in each of the five categories listed below:

<b>Category</b>	<b>Minimum Credits</b>
a. Management of Technology . . . . .	8 including 5.801
b. Operations Research and Quantitative Techniques . . . . .	8 including 5.963
c. Production Engineering . . . . .	4
d. Financial and Operational Controls . . . . .	4 including 5.830
e. Computer and Information Systems . . . . .	<u>4</u>
<b>TOTAL</b>	<b>28</b>

The remaining 12 quarter hours required for the degree may be considered as free electives. These may be taken within the course offering for this program or from any courses in graduate engineering and mathematics for which the student has adequate preparation. Up to six quarter hours may be elected in other graduate schools subject to the approval of the adviser for this program and the director of the graduate school in which the course is offered. Students desiring courses in such subjects as economics, business law, labor relations, or marketing, should consult the *Graduate School of Business Administration Catalog*. The amount of credit applied toward the degree must be established by the Department.

Courses in the five categories from which students must select to meet the indicated minimum total of 28 quarter hours of credit are listed below. Unless otherwise specified, all courses are for two quarter hours of credit.

**a. Management of Technology**

- 5.801 & 5.802 Analysis of the Industrial Enterprise I and II
- 5.803 Industrial Organizations
- 5.812 Managing Professional Personnel
- 5.813 Engineering Communication
- 5.814 Development of Engineering Managers
- 5.816 Industrial Psychology for Engineers
- 5.820 Personnel Administration for Engineers
- 5.823 Advanced Production Analysis (4 q.h.)
- 5.841 Engineering Project Management

**b. Operations Research & Quantitative Techniques**

- 5.903 Inventory Control and Production Planning
- 5.904 Queuing Theory and Its Applications
- 5.905 Analysis with Simulation
- 5.906, 7 Principles of Dynamic Systems
- 5.909 Systems Engineering and Analysis

- 5.911 Linear Programming
- 5.912 Network Planning and Control
- 5.914 Advanced Operations Research (4 q.h.) (or 5.9A4, 5.9B4)
- 5.916 Engineering Analysis Utilizing Data Processing
- 5.953 Statistical Decision Theory
- 5.954 Advanced Quality Control
- 5.956 Mathematical Theory of Reliability
- 5.957 Designing for Reliability
- 5.963 Statistics
- 5.964 Des. of Exp. I
- 5.965 Des. of Exp. II

**c. Production Engineering and Man/Machine Systems**

- 5.806 Production Forecasting
- 5.817 Advanced Work Design
- 5.819 Human Factors in Man/Machine Systems
- 5.822 Product Design and Value Analysis
- 5.823 Advanced Production Analysis (4 q.h.)
- 5.825 Topics in Production Engineering
- 5.853 Man Computer Interaction
- 5.862 Intro. to Occ. Health, Safety
- 5.863 Technical Aspects of Health, Safety
- 5.903 Inventory Control and Production Planning
- 5.912 Network Planning and Control
- 5.954 Advanced Quality Control
- 5.955 Reliability and Maintainability Applications

**d. Financial and Operational Controls**

- 5.805 Industrial Budgeting for Engineers
- 5.809 Advanced Engineering Economy
- 5.811 Cost Accounting for Engineers
- 5.830 & 5.831 Financial Management I and II
- 5.940 Basic Information Systems Technology
- 5.941 Management Information Systems

**e. Computer and Information Systems**

- 5.853 Man Computer Interaction
- 5.905 Analysis with Simulation
- 5.906, 5.907 Principles of Dynamic Systems I and II
- 5.916 Engineering Analysis Utilizing Data Processing
- 5.930 Basic Computer Systems Technology
- 5.931 Computer Systems
- 5.932 Advanced Computer Systems
- 5.940 Basic Information Systems Technology
- 5.941 Management Information Systems
- 5.942 Advanced Management Information Systems

- 5.943 Management Decision Systems Seminar
- 3.894 Digital Computer Programming II
- 3.895 Digital Computer Programming III
- 3.972 Electronic Digital Computers I
- 3.973 Electronic Digital Computers II
- 3.974 Electronic Digital Computers III
- 3.985 Fundamentals of Automatic Digital Machines I
- 3.986 Fundamentals of Automatic Digital Machines II
- 3.987 Fundamentals of Automatic Digital Machines III
- 3.988 Special Topics in Computer Science
- 3.989 Computer Peripherals

### **COMPUTER AND INFORMATION SYSTEMS MAJOR**

The Computer and Information Systems (C & IS) Major is designed to meet the needs of three distinct but related professional areas — computer systems, information systems, and management.

A unique two track curriculum offers sets of courses in computer systems and information systems, each track tailored for particular specialties but integrated with material from the other track for general management. The computer system track focuses on basic concepts and their implementation in hardware and software systems. The information systems track focuses on supporting the management decision process — evaluation, analysis, and design of management information and decision systems.

The number of courses required from each track depends upon the students professional objectives. Unique programs can be designed in consultation with the adviser. All C & IS majors will be expected to take the ten or sixteen quarter hours of courses listed below as general requirements. In addition they are required to take at least sixteen quarter hours from category (e), computer information systems. It is suggested that students within this major follow one of the two course tracks listed below as a portion of the sixteen quarter hour requirement. Exception to these regulations must be approved in a consultation with an adviser.

<b>General Requirements</b>	<b>Minimum Credits</b>
Management of Technology;	
5.801 Analysis of the Ind. Enterprise I . . . . .	2
Operation Research & Quantitative Techniques	
5.905 Analysis with Simulation . . . . .	2
5.963 Statistics . . . . .	2
Production Engineering	
Elective within category . . . . .	2
Financial Controls	
5.830 Financial Management I . . . . .	2
Thesis	
5.991 (Required of Industrial Engineering majors) . . . . .	<u>6</u>
	10 or 16



**Two Track Course List****Computer Systems Track**

- 5.930 Basic Computer Systems Technology
- 5.931 Computer Systems
- 5.932 Advanced Computer Systems

**Information Systems Track**

- 5.940 Basic Information Systems Technology
- 5.941 Management Information Systems
- 5.942 Advanced Management Information Systems
- 5.943 Management Decision Systems

**OPERATIONS RESEARCH MAJOR**

The following courses are required of students electing the Operating Research major:

	<b>Credits</b>
5.963 Statistics . . . . .	2
5.801 Analyses of the Industrial Enterprise . . . . .	2
5.830 Financial Management I . . . . .	2
5.914 Advanced Operations Research . . . . .	4
5.991 Thesis (required of Industrial Engineer majors) . . . . .	6
	<u>10 or 16</u>

In addition to the above required courses, the student must earn the minimum number of credits in each of the categories listed below.

<b>Category</b>	<b>Minimum Credits</b>
b. Quantitative Techniques . . . . .	8
c. Production Engineering . . . . .	4
e. Computer Systems . . . . .	4
Math-oriented courses (listed below) . . . . .	4
5.910 Analytical Techniques for Engineers	
*10.8B4 Advanced Calculus I	
*10.8B5 Advanced Calculus II	
*10.8B6 Advanced Calculus III	
*10.8G8 Stochastic Processes I	
*10.8G8 Stochastic Processes II	

The remaining hours required for the degree may be considered as free electives. These may be taken within the course offerings for this program or from any courses in graduate engineering or mathematics for which the student has adequate preparation. Up to six quarter hours may be elected in other graduate schools subject to the approval of the adviser for this program and the director of the graduate school in which the course is offered.

\*See Graduate School of Arts and Science Catalogue.

## THE INDUSTRIAL ENGINEER DEGREE

### Description

This degree is designed for those who wish to undertake graduate study beyond the master's degree which is less extensive and more applied than that required for the doctorate. The program leading to the Industrial Engineer degree permits a candidate to pursue a course of study at the upper graduate level which will develop in-depth knowledge in selected Industrial Engineering techniques, and the ability to apply these techniques to complex problems in a real world setting. The offering of this degree is pending approval of the Graduate Council.

### Admission

Applicants to the Industrial Engineer Degree program must be enrolled for graduate study in Industrial Engineering or Engineering Management. To be accepted for candidacy for the degree, applicants must possess the master's degree in Industrial Engineering or equivalent from a recognized institution. Further, an applicant for candidacy must have the potential capability to structure and solve complex real-world problems. Evidence of this capability may be in the form of a thesis completed as a requirement for the Master of Science Degree, or in such other form which is acceptable to the Industrial Engineering Department Graduate Committee.

### Credit Requirements

A minimum of 40 quarter hours beyond the master's degree is required. Normally 10 quarter hours of credit out of the 40 will be granted for work on the Industrial Engineering Degree project. A minimum of 20 quarter hours must be taken in Industrial Engineering.

### Industrial Engineer Degree Project

In addition to the required course work, to be awarded the degree of Industrial Engineer, the candidate must complete a project demonstrating a high level of competence in structuring and solving a complex real-world problem. The problem to be addressed in this project is of an applied nature. Where applicable an on-going organization will be used as the setting. The work should lead to a solution which satisfies all technological and organizational constraints, and is therefore capable of being implemented. The topic will be selected by the student and his project committee.

### Qualifications and Examinations

A student must maintain a "B" average to qualify for the degree. A final oral examination for defense of the written report of the Industrial Engineer Degree project conducted by the student's committee is also a requirement for the degree.

**Residence Requirement**

Since the Industrial Engineer Degree project requires the structuring and solving of a complex problem, residence requirements will be satisfied by that arrangement which allows the student to devote a sufficient portion of his time to the project to permit an intensive problem-solving experience.

# **graduate program in transportation (interdisciplinary)**

## **Admission**

Individuals who have an interest in Transportation Planning and have an undergraduate degree in Engineering or Economics or who have an appropriate mathematics background are permitted to enroll in the Interdisciplinary Transportation Program. Inquiries should be addressed to: Northeastern University Graduate School of Engineering, Interdisciplinary Transportation, 214 Hayden Hall, Boston, Massachusetts 02115.

## **MASTER OF SCIENCE IN TRANSPORTATION**

Northeastern University has established a "Master of Science in Transportation" degree program to deal with the special needs of individuals who are preparing themselves for careers in transportation planning. The individual's program of study will aid the individual to acquire the necessary technical skills and social science background required for a transportation planner. Courses from the Colleges of Engineering, Liberal Arts and Business Administration may be included in the student's program of study. In addition to the in-class training, a student will undertake an independent study project that results in a Master's Thesis or Master's Report. A student will work closely with an advisor on some related problem. Arrangements have been made with local government agencies to involve the students with particular real world problems.

## **Full-Time Program**

The program is arranged in a manner to allow a student to complete the program in one calendar year. Normally, a student will enroll in course work for three academic quarters beginning in September. The student will be eligible for graduation the following September if all course and thesis or report work is complete.

## **Part-Time Program**

The Part-Time Program is the same as the Full-time Program. The part-time student has a maximum of seven years to complete all degree requirements.

## **Program of Study**

Each student enrolled in the program is required to prepare a program of study which consists of required courses and electives in transportation

and related fields. If a student is lacking the necessary mathematics, economics or statistics background, the student may enroll in the prerequisite courses and receive graduate credit. The program of study must consist of a minimum of forty quarter hours of credit and must be approved by the student's advisor.

Required courses		Credits
1.834	Transportation Analysis and Planning	4
1.800	Systems Analysis I	4
22.847	Politics of Transportation	3
39.9L5	Economics of Urban Transportation	3
48.801	Seminar in Transportation Systems	3
93.837	Interdisciplinary Urban Transportation Seminar	2
93.820	Thesis	6

### Suggested Electives

1.801	Systems Analysis II	4
1.805	Traffic Flow Theory	4
1.806	Urban Transportation Analysis	4
1.819	Environmental Impacts of Urban Transportation	4
1.820	Transportation Engineering	2
5.904	Queuing Theory	2
5.905	Analysis with Simulation	2
5.913	Data Processing (Fortran)	2
5.914	Advanced Operations Research	4
5.818	Management Information Systems	2
21.886	Seminar in Social Research Issues	3
22.845	Problems in Municipal Administration	3
22.846	Problems in Urban and Regional Development	3
39.9K1	Regional Economics	3
39.9L1	Urban Economics I	3
39.9L2	Urban Economics II	3
39.277	Economics of Urban Environment	3
39.276	Economics of Energy Resources	3
39.9L7	Economics of Intercity Transportation	3
39.9R1	Seminar in Development Planning	3
93.818	Special Topics of Transportation	3

### Pre-Requisites (Graduate credit awarded toward M.S. in Transportation Degree)

39.9A0	Intermediate Microeconomic Theory	0
1.206	Applied Probability Theory for Civil Engineers	4
	or	
5.960	Engineering Statistics I	2
5.961	Engineering Statistics II	2

# description of courses

*All courses carry two quarter hours of credit unless otherwise noted. Not all courses are offered every year. Refer to the Graduate School of Engineering circular issued about July 1 each year for the courses to be offered in the new academic year and the times at which they are scheduled to meet.*

## CIVIL ENGINEERING

### **1.206 Applied Probability Theory for Civil Engineers** (4 q.h. credits)

The basic elements of probability theory and their use via the solution of various civil engineering problems encountered in fluid mechanics, construction management, structures, transportation, etc. Probability of events, random variables and distribution, derived distribution, expectation, and common probability models. *Prep. Admission to Graduate School of Engineering.*

### **1.800 Systems Analysis 1** (4 q.h. credits)

The use of quantitative techniques to allocate resources in the planning and design of large physical systems encountered in transportation and environmental engineering. Economic analysis of alternatives; development of mathematical models; classical optimization techniques by calculus; linear programming and extensions; integer, quadratic, separable and approximation programming methods; ranging analysis; network theory. *Prep. Two semesters of calculus.*

Offered yearly, fall quarter, days

### **1.801 Systems Analysis II** (4 q.h. credits)

Additional quantitative techniques for planning and design. Treatment of multi-objective systems; dynamic and geometric programming; decision analysis for selection; utility theory; Markov chains; gaming; introduction to simulation. *Prep. 1.800, Systems Analysis I.*

Offered yearly, winter quarter, days.

### **1.803 Traffic Flow Theory I**

Statistical methods in traffic flow theory; probability models, hypothesis testing and its use, queuing theory and simulation techniques. *Prep. 5.950, Engineering Statistics I or equivalent.*

Offered 1977-78, fall quarter

### **1.804 Traffic Flow Theory II**

Deterministic methods in traffic flow theory; car following models; various methods of analogy, capacity and level of service. *Prep. 1.803, Traffic Flow Theory I.*

Offered 1977-78, winter quarter

### **1.805 Traffic Flow Theory** (4 q.h. credits)

This course, offered days, embodies the material in 1.803 and 1.804, Traffic Flow Theory I and II. *Prep. 5.950, Engineering Statistics I or equivalent.*

Offered yearly, winter quarter

**1.806 Urban Transportation Analysis** (4 q.h. credits)

Principles of the analysis of urban transportation networks utilizing contemporary methodology such as cross-elasticity models, disaggregate-behavioral (probalistic) models, and network equilibrium concepts. *Prep. 1.834, Transportation Analysis and Planning.* Offered yearly, winter quarter.

**1.819 Environmental Impacts of Urban Transportation** (4 q.h. credits)

Examination of the human response to noise, water and air pollution; physical effects of pollution in relation to source-receptor configurations and urban scale meteorology; laboratory and field techniques used in measuring pollutant levels; government regulations and guidelines and their effect on urban transportation planning. *Prep. Admission to Graduate School of Engineering.*

**1.820 Transportation Engineering** (2 q.h. credits)

Description and evaluation of different modes of transportation existing and proposed; their performance and cost characteristics; design, performance, and selection criteria for vehicles and roadbeds. *Prep. Admission to Graduate School of Engineering.*

**1.824 Civil Engineering Materials I** (2 q.h. credits)

The behavior of civil engineering materials subjected to various loading and environmental conditions. Includes atomic structure and bonding, elastic and plastic behavior of metals, strength and durability of wood, concrete, and bituminous mixes.

**1.825 Civil Engineering Materials II** (2 q.h. credits)

Continuation of 1.824. Includes composite materials, phase transformations, corrosion, strengthening mechanisms.

**1.834 Transportation Analysis and Planning** (4 q.h. credits)

Principles of the analysis of transportation networks, through the use of the conventional forecasting model system, including trip generation, trip distribution, modal split and traffic assignment. Offered yearly, fall and winter quarter

**1.837 Interdisciplinary Urban Transportation Seminar**

Review and presentation of research and public policy on broad topics in transportation. Guest lecturers and formal paper presentations. *Prep. Permission of Civil Engineering Department.*

**1.838 Master's Report** (Transportation) (4 q.h. credits)

An individual effort in an area selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department.*

Offered yearly, all quarters

**1.839 Thesis** (Master's Degree) (6 q.h. credits)

Analytical and/or experimental work conducted by arrangement with and under the supervision of the department. *Prep. Permission of the Civil Engineering Department.* Offered yearly, all quarters

### **1.841 Structural Analysis I**

Review of basic principles of structural analysis, determinacy, indeterminacy, stability. Introduction to energy methods including virtual work and Castigliano's Theorem. *Prep. Differential and Integral Calculus plus Theory of Structures.*

Offered yearly, fall quarter

### **1.842 Structural Analysis II**

Contemporary methods of structural analysis with emphasis on lateral load analysis of multistory structures. A complete treatment of moment distribution including non-prismatic members, axial load, and shear distribution. *Prep. 1.841 Structural Analysis I.*

Offered yearly, winter quarter

### **1.843 Structural Analysis III**

Introduction to matrix methods of structural analysis, including stiffness and flexibility methods. *Prep. 1.842, Structural Analysis II.*

Offered yearly, spring quarter

### **1.844 Structural Analysis IV**

Introduction to advanced structural mechanics, emphasis on theory of elasticity, and development of finite element method of analysis. *Prep. 1.843 Structural Analysis III.*

Offered 1977-78, fall quarter

### **1.847 Structural Analysis (4 q.h. credits)**

This course, offered days, embodies the material in 1.841 and 1.842 — Structural Analysis I and II. *Prep. Differential and Integral Calculus plus Theory of Structures.*

Offered yearly, fall quarter

### **1.849 Model Analysis**

Development of the principles of similitude to establish the relationship between behavior in the model and the full-sized structure. Review of techniques to fabricate, to load, and to instrument models. Application and use of strain gauges. The laboratory portion is devoted to model analysis of a complex structure. *Prep. Admission to program and approval of instructor.*

Offered 1977-78, spring quarter

### **1.850 Structural Dynamics I**

Analysis by exact and approximate methods of structures subjected to dynamic loads.

Offered 1977-78, winter quarter

### **1.851 Structural Dynamics II**

Continuation of 1.850 with application to the analysis of structures subjected to blast loads and seismic loadings. *Prep. 1.850, Structural Dynamics I.*

Offered 1977-78, spring quarter

### **1.853 Concrete Structures I**

Review of basic characteristics of concrete. Structural forms appropriate for reinforced and prestressed concrete. Prestressed concrete design. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*

Offered yearly, fall quarter

### **1.854 Concrete Structures II**

Continuation of Concrete I. Additional topics on prestressed concrete design, yield line theory, and folded plate design. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*

Offered yearly, winter quarter



**1.855 Concrete Structures III**

Analysis and design of thin-shell concrete structures including domes, cylindrical shells, and hyperbolic paraboloids. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*  
Offered yearly, spring quarter

**1.856 Structural Analysis (4 q.h. credits)**

This course, offered days, embodies the course content offered in 1.843, Structural Analysis III and 1.844, Structural Analysis IV. *Prep. 1.847, Structural Analysis.*  
By arrangement

**1.857 Structural Dynamics (4 q.h. credits)**

This course, offered days, embodies the material in 1.850 and 1.851 — Structural Dynamics I and II.  
Offered yearly, spring quarter

**1.858 Concrete Structures (4 q.h. credits)**

This course, offered days, embodies the material in 1.853 and 1.854 — Concrete Structures I and II. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*  
By arrangement

**1.859 Structural Stability**

Elastic and inelastic stability of structures including beams, columns, plates, and shells.  
Offered 1976-77, fall quarter

**1.861 Design of Structures I**

An advanced course in elastic design in structural steel. Design problems involving braced and rigid frame structures subject to gravity, wind, and seismic loads are considered. *Prep. Undergraduate Steel Design and Structural Analysis*  
Offered yearly, fall quarter

**1.862 Design of Structures II**

An advanced course in analysis and design in structural steel with emphasis on plastic behavior including rigid frame buildings and braced multistory frame buildings. *Prep. Undergraduate Steel Design and Structural Analysis.*  
Offered yearly, winter quarter

**1.863 Design of Structures III**

Advanced problems in elastic and plastic design of structural steel. Topics include curved girders and cable supported structures. *Prep. Undergraduate Steel Design and Structural Analysis.*  
Offered yearly, spring quarter

**1.864 Design of Structures (4 q.h. credits)**

This course, offered days, embodies the material in 1.862 and 1.863 — Design of Structures II and III. *Prep. Undergraduate Steel Design and Structural Analysis.*  
By arrangement

**1.871 Engineering Properties of Soils I**

Review of phase relationships, soil consistency, etc.; permeability and capillarity; effective stress concept, analysis of seepage in porous media; stress distribution; introduction to settlement analysis. *Prep. Undergraduate course in basic soil mechanics.*  
Offered yearly, fall quarter

**1.872 Engineering Properties of Soils II**

A continuation of course 1.871. The course covers consolidation theory and settlement analysis; shear strength properties of soils; stability analysis of open and braced cuts; and earth pressure theory and analysis. *Prep. 1.871, Engineering Properties of Soils I.* Offered yearly, winter quarter

**1.873 Soils Testing Laboratory**

Emphasis on the soil behavior aspects of consolidation theory, settlement analysis, and shear strength. Approximately one-half of the term is devoted to laboratory studies in soil compaction, consolidation, and shear strength. *Prep. 1.871, Engineering Properties of Soils I.* Offered yearly, spring quarter

**1.874 Foundation Engineering I**

Soil compressibility; case studies of deep-seated settlement; allowable settlements; preloading concepts; bearing capacity; subsurface exploration. *Prep. Undergraduate Soil Mechanics or Foundations.* Offered 1976-77, fall quarter

**1.875 Foundation Engineering II**

Design principles of footings, mats and floating foundations; pile foundations; selection of foundation scheme; case studies. *Prep. 1.874, Foundation Engineering I.* Offered 1976-77, winter quarter

**1.876 Foundation Engineering III**

Lateral earth pressure theory; analysis and design of retaining walls, anchored bulkheads and braced cofferdams; dewatering; observational approach to design; foundation performance with case studies; cellular cofferdams. *Prep. 1.875, Foundation Engineering II.* Offered 1976-77, spring quarter

**1.877 Engineering Properties of Soil (4 q.h. credits)**

This course, offered days, embodies the material in 1.871 and 1.872 — Engineering Properties of Soils I and II. *Prep. Undergraduate course in basic soil mechanics.* Offered yearly, fall quarter

**1.878 Foundation Engineering (4 q.h. credits)**

This course, offered days, embodies the course content offered in 1.874 and 1.875 — Soil Mechanics and Foundation Engineering I and II. *Prep. Undergraduate Soil Mechanics or Foundations.* Offered yearly, spring quarter

**1.882 Engineering Geology**

Review of minerals, selected topics in historical and structural geology related to engineering geology; origin and occurrence of various rock types, geologic structures, faulting and joint systems; weathering of rock and weathering products, glaciation, geologic mapping and environmental aspects. *Prep. Undergraduate course in geology.* Offered 1977-78, fall quarter

**1.894 Rock Mechanics I**

Interrelationship with other disciplines; index properties; classification systems; laboratory tests; state of stress and stress distribution. *Prep. Undergraduate course in geology* Offered 1977-78, winter quarter

**1.885 Rock Mechanics II**

Behavior of rock under combined stresses; pore pressure effects; failure theories; in-site deformation modulus and shear strength characteristics; field testing. *Prep. Undergraduate course in geology.* Offered 1977-78, spring quarter

**1.892 Numerical Methods in Structural Mechanics I**

Formulation and numerical solution of civil engineering problems in structural mechanics. Emphasis will be on lumped parameter systems. Equilibrium, eigenvalue, and propagation type problems will be covered.

Offered 1976-77, winter quarter

**1.893 Numerical Methods in Structural Mechanics II**

Continuation of 1.892. *Prep. 1.892, Numerical Methods in Structural Mechanics I.*

Offered 1976-77, spring quarter

**1.894 Numerical Methods in Structural Mechanics (4 q.h. credits)**

This course, offered days, embodies the material in 1.892 and 1.893 — Numerical Methods in Structural Mechanics I and II.

Offered yearly, winter quarter

**1.897 Master's Report (Structural) (4 q.h. credits)**

An individual effort consisting of laboratory and/or literature investigation and analysis or advanced design of a project in an area of structural engineering selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department.*

Offered yearly, all quarters

**1.898 Special Topics in Structural Engineering (2 q.h. credits)**

An individual effort in an area selected by student and adviser resulting in a definitive report. Open to day students only. *Prep. Admission to Graduate School of Engineering.*

Offered yearly, all quarters

**1.899 Thesis (Master's Degree) (8 q.h. credits)**

Analytical and/or experimental work conducted by arrangement with and under supervision of the department. *Prep. Permission of the department.*

Offered yearly, all quarters

**1.901 Hydraulics I**

Mechanical properties of fluids — fluid statics, continuity, energy relationships (Bernoulli and Euler equations), momentum, dimensional analysis, steady flow in conduits under pressure, pipe systems. *Prep. Undergraduate course in hydraulics.*

Offered yearly, fall quarter

**1.902 Hydraulics II**

Open channel flow — energy relationships, critical flow, controls, momentum principles, flow resistance, uniform flow, gradually varied flow, local phenomena. *Prep. 1.901, Hydraulics I.*

Offered yearly, winter quarter

**1.903 Hydraulics III**

Open channel flow — channel transitions; unsteady flow; potential flow — velocity potential function and stream function; selected topics in hydraulics and fluid mechanics. *Prep. 1.902, Hydraulics II.*

Offered yearly, spring quarter

**1.904 Hydraulics (4 q.h. credits)**

This course, offered days, embodies substantially the material in 1.902 and 1.903 — Hydraulics II and III. *Prep. Undergraduate course in hydraulics.*

Offered yearly, winter quarter

**1.907 Environmental Statistics**

Statistical studies applied to environmental data, including basic statistics; frequency and probability distributions; methods of frequency analysis; multiple linear regression and correlation analysis; introduction to mathematical modeling of environmental processes including discussion of deterministic and stochastic processes. *Prep. Admission to Graduate School of Engineering.*

Offered yearly, fall quarter

**1.908 Hydrology I**

Hydrologic cycle; precipitation studies including data adjustment, spatial and temporal variability, intensity-duration-frequency relationships; abstractions of water due to evapotranspiration and infiltration; groundwater flow, including flow nets and well hydraulics; runoff studies including data adjustment, runoff volume, peak flows, unit hydrographs, flood formulas, and drainage design. *Prep. Not to be taken by students who have completed 1.905.*

Offered yearly, winter quarter

**1.909 Hydrology II**

Drainage and river basin morphology; hydrogeology; streamflow and streamflow routing; storage models of runoff; reservoir routing and design; floods and flood control; case studies in hydrology; water law and policy, urbanization and its effects, reservoir system operation and regulation, alternative uses of water resources, and multipurpose projects; conservation and reuse of water. *Prep. Hydrology I. Not to be taken by students who have completed 1.906.*

Offered yearly, spring quarter

**1.910 Water and Wastewater Treatment I**

Water quality, water impurities and effects, the theory and practice of water treatment, and the elements of design of water treatment works including intake facilities, wells, filtration, coagulation, sedimentation, softening, iron and manganese removal, disinfection, and fluoridation. *Prep. 1.921, Environmental Chemistry II, or equivalent.*

Offered yearly, fall quarter

**1.911 Water and Wastewater Treatment II**

Waste characteristics, the theory and practice of wastewater treatment and disposal, and the elements of design of primary and secondary treatment works, including screening, grit removal, sedimentation, biological treatment processes, sludge digestion and disposal, stabilization ponds, and disinfection. *Prep. 1.910, Water and Wastewater Treatment I.*

Offered yearly, winter quarter

**1.912 Water and Wastewater Treatment III**

Salt water conversion, advanced wastewater treatment, and other special problems in water and wastewater characteristics and treatment, including corrosion control, application of chemicals, radioactive wastes, thermal pollution, and treatment plant instrumentation. *Prep. 1.911, Water and Wastewater Treatment II.*

Offered yearly, spring quarter

Offered yearly, winter quarter, days

**1.913 Industrial Waste Disposal**

Evaluation of industrial waste problems and development of process design for the required treatment facilities; study of various manufacturing processes and their wastewater problems; industrial waste survey techniques; characteristics of industrial wastes; waste reduction methods; physical, chemical, biological, and advanced treatment methods; industrial wastewaters and disposal and treatment of industrial solids and liquids. *Prep. 1.912, Water and Wastewater Treatment III and 1.921, Environmental Chemistry II.*

Offered yearly, fall quarter

**1.914 Water & Wastewater Treatment (4 q.h. credits)**

This course, offered days, embodies the material in 1.910 and 1.911 — Water and Wastewater Treatment I and II. *Prep. Two undergraduate semesters of hydraulics.*

Offered yearly, fall quarter

**1.920 Environmental Chemistry I**

Analytical chemistry principles are studied with reference to environmental engineering applications. The chemistry of processes such as coagulation, iron and manganese removal, ion exchange, softening, and disinfection are included. The principles of spectroscopy and polarography are also discussed. *Prep. Two semesters of general chemistry.*

Offered yearly, fall quarter

**1.921 Environmental Chemistry II**

A continuation of 1.920 including gas transfer, oxidation and reduction, and radiation chemistry. Reaction rates with reference to environment engineering applications such as BOD are discussed. Topics in organic chemistry and instrumental analysis are included. *Prep. 1.920, Environmental Chemistry I.*

Offered yearly, winter quarter

See NOTE below regarding courses 1.921, 1.922, and courses 1.930, 1.931.

**1.922 Environmental Bacteriology**

A study of bacteriology with emphasis on environmental engineering applications. The course includes cell structure, nutrition, morphology, growth, reproduction, and metabolism of bacteria. Effects of environmental factors including inhibition, killing, and natural habitats are discussed. Methods of quantitative bacteriology are also covered. *Prep. 1.921, Environmental Chemistry II.*

Offered yearly, spring quarter

**1.923 Environmental Chemistry (4 q.h. credits)**

This course, offered days, embodies the material in 1.920 and 1.921 — Environmental Chemistry I and II. *Prep. Two semesters of general chemistry.*

Offered yearly, fall quarter

**1.930 Environmental Analysis I**

A laboratory course for the analytical measurement of environmental conditions. Physical, chemical, and biological characteristics are determined by the latest analytical methods with emphasis on their fundamental principles and operational techniques. Interpretation of analytical results for practical applications is also stressed. *Prep. 1.921, Environmental Chemistry II.*

Offered yearly, winter quarter

NOTE: It is strongly recommended that this course and 1.931 be taken simultaneously with 1.921 and 1.922.

**1.931 Environmental Analysis II**

The laboratory analyses are continued with emphasis on the chemical and biological analyses associated with treatment methods; microbiological techniques utilizing microscopy and membrane filter preparation; emphasis on environmental reports. *Prep. 1.930, Environmental Analysis I.* Offered yearly, spring quarter

**1.933 Environmental Analysis (4 q.h. credits)**

This course, offered days, embodies the material in 1.930 and 1.931 — Environmental Analysis I and II. *Prep. 1.923, Environmental Chemistry taken simultaneously.* Offered yearly, fall quarter

**1.935 Unit Operations in Environmental Engineering I**

Laboratory scale unit operations illustrating the physical, chemical and biological principles involved in water and wastewater treatment. The aim is to obtain criteria for system design. Topics include disinfection, water softening, sedimentation, chemical coagulation, and ion exchange. *Prep. 1.931, Environmental Analysis II* Offered yearly, winter quarter

**1.936 Unit Operations in Environmental Engineering II**

A continuation of 1.935. Topics include biodegradability studies using activated sludge, anaerobic digestion, vacuum filtration, and chemical-physical process involved in wastewater treatment. A comprehensive evaluation of each unit process is required in a report from each student. *Prep. 1.935, Unit Operations in Environmental Engineering I.* Offered yearly, spring quarter

**1.938 Unit Operations in Environmental Engineering (4 q.h. credits)**

This course, offered days, embodies the material in 1.935 and 1.936 — Unit Operations in Environmental Engineering. *Prep. 1.933, Environmental Analysis and 1.913, Industrial Waste Disposal.* Offered yearly, spring quarter

**1.940 Public Health Engineering Survey**

An historical survey of public health conditions to introduce the student to the modern approach to public health engineering problems. Applications of engineering principles to such problems as garbage and refuse disposal, control of insect-borne diseases, milk and food sanitation, rodent control, camp and recreational sanitation, housing, control of atmospheric pollution, and radiological health. *Prep. Admission to Graduate School of Engineering.* Offered by special arrangement

**1.945 Solid Waste Management**

Basic solid waste management for engineering and science students covering storage, collection practices, sanitary landfill principles, incineration practices and reclamation possibilities. *Prep. Admission to Graduate School of Engineering.* Offered yearly, fall quarter

**1.950 Air Pollution Engineering**

Theory and practice related to engineering management of air resources; applications of models for the atmospheric dispersion of pollutants; analysis of control systems for gaseous and particulate emissions utilizing dry collection, wet collection, absorption, and catalytic processes. Discussion of source control evaluation and air quality standards. Course 1.957 is recommended. *Prep. Admission to Graduate School of Engineering.* Offered yearly, fall quarter

**1.951 Radiological Health Engineering**

Types and sources of radioactive wastes, methods of handling, storage, and disposition of solid, liquid, and gaseous radioactive wastes. Regulatory agency requirements. *Prep. Admission to Graduate School of Engineering.*

Offered by special arrangement

**1.952 Industrial Hygiene**

Characterization and control of industrial problems associated with noise, heat and ventilation. Physical and biological aspects of environmental stress are discussed. Emphasis is placed on the application of engineering principles to the design of control systems. Evaluation procedures for control effectiveness are reviewed. *Prep. Admission to Graduate School of Engineering.*

Offered yearly, spring quarter

**1.953 Environmental Microbiology**

An advanced course in environmental microbiology. Anaerobic decomposition and eutrophication; transformations of environmental products containing compounds of sulfur, nitrogen, complex hydrocarbons and pesticides. Advanced techniques for the simulation and evaluation of microbiological systems applied to biological control of water and wastewater. *Prep. 1.922, Environmental Bacteriology.*

Offered by special arrangement

**1.954 Stream Sanitation**

Analysis of the disposal of conservative and non-conservative pollutants in streams. Topics include water quality standards, BOD and oxygen relationships in streams, bacterial pollution, eutrophication, thermal pollution, and general corrective control methods in streams. *Prep. 1.920, Environmental Chemistry I.*

Offered yearly, spring quarter, evenings

Offered yearly, fall quarter, days

**1.955 Air Sampling and Analysis**

A laboratory course on air pollution measurements utilizing physical, chemical, and instrumental methods and calibration and use of sampling equipment for gaseous and particulate pollutants. Identification and quantitative measurements of pollutants are performed utilizing microscopy, spectrophotometry, gas chromatography, and atomic absorption spectroscopy. *Prep. 1.950, Air Pollution.*

Offered yearly, spring quarter

**1.956 Air Pollution Control (4 q.h. credits)**

This course, offered days, embodies the material of 1.950, Air Pollution Engineering and 1.955, Air Sampling and Analysis. *Prep. Admission to Graduate School of Engineering.*

Offered yearly, winter quarter

**1.957 Air Pollution Science**

Biological and chemical aspects of air pollution with emphasis on the toxicological aspects of the environment, physiological effects of aerosols, analysis of organic and inorganic constituents of the atmosphere and rationale for establishment of air quality criteria and standards. Note: Course 1.957 is open to non-engineering graduate students as well as engineering graduate students. *Prep. Consent of the department and instructor.*

Offered yearly, winter quarter

**1.960 Hydraulic Structures I**

Dams and associated structures. Design criteria and preliminary analyses for gravity, arch, buttress, rock-fill and earth-fill dams. Foundation treatment and scour protection. Spillway structures. Gates. Navigation requirements of large rivers. Fishways. *Prep. Undergraduate course in hydraulics.* Offered yearly, fall quarter

**1.961 Hydraulic Structures II**

Intake structures in reservoirs and on rivers. Tunnels and pipe lines: design criteria and structural analyses; economic studies for diameter selection. Penstocks and anchor blocks. Canals — seepage and erosion, linings, canal structures. *Prep. Undergraduate course in hydraulics.* Offered yearly, winter quarter

**1.962 Hydraulic Structures III**

Surge tanks: selection of type. River regulation: design principles, flood protection and navigation requirements, bank revetments, groins, dikes, and levees. Cofferdams. Operation and maintenance of hydraulic structures. *Prep. Undergraduate course in hydraulics.* Offered yearly, spring quarter

**1.970 Design of Environmental Systems (4 q.h. credits)**

The development of comprehensive engineering reports. Fundamental design concepts of complete systems for environmental control, including water treatment; wastewater disposal, air quality control, and solid waste disposal; evaluation of economic alternatives for environmental quality control; discussion of actual engineering reports and designs will include considerations of the logic and conclusions. *Prep. 1.912, Water and Wastewater Treatment III.*

Offered yearly, spring quarter, days

**1.980 Environmental Planning and Management**

Examination of the social, technological, economic, political, legal and institutional aspects of environmental planning and management; environmental impact and assessment considerations related to development projects; environmental planning methodology and techniques. *Prep. Admission to the Graduate School of Engineering.*

Offered yearly, fall quarter

**1.985 Environmental Protection**

Environmental quality and its effects on health, comfort, aesthetics, balance of ecosystems and renewable resources; interaction of the water-land-air complex, vector control, food protection, ionizing radiation, other radiation, and the energies of heat and sound. *Prep. Admission to the Graduate School of Engineering.*

Offered yearly, spring quarter

**1.991 Thesis (Master's Degree) (8 q.h. credits)**

Analytical and/or experimental work conducted by arrangement with and under the supervision of the department. *Prep. Permission of the Civil Engineering Department.*

Offered yearly, all quarters

**1.992 Special Topics in Environmental Engineering (2 q.h. credits)**

An individual effort in an area selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department*

Offered yearly, all quarters



**1.993 Master's Report Environmental Engineering** (4 q.h. credits)

An individual effort consisting of laboratory and/or literature investigation and analysis or advanced design of a project in an area of environmental engineering selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department.* Offered yearly, all quarters

**1.994 Seminar — Environmental Engineering**

Discussions by professional engineers and scientists, faculty, and graduate students on subjects in the area of environmental engineering and science. Open to day students only. *Prep. Consent of the instructor.*

Offered by special arrangement, days

**1.996 Seminar — Environmental Health**

Discussion by professional people in the public health field, faculty, and graduate students on subjects within the area of environmental health. Open to day students only. *Prep. Consent of the instructor.*

Offered by special arrangement, days

**1.997 Thesis** (Ph.D. Degree)

Open to day students only. *Prep. Admission to doctoral program in Environmental Engineering* Offered yearly, all quarters

**MECHANICAL ENGINEERING**

The courses listed below are of an advanced undergraduate — first year graduate level. A maximum of eight (8) quarter hours of credit from this group of courses may be applied toward the master's degree.

Course	Credits
2.214 Experimental Stress Analysis . . . . .	4
2.232 Engineering Materials . . . . .	4
2.233 Thermodynamics of Propulsion . . . . .	4
2.235 Statistical Thermodynamics . . . . .	4
2.236 Nuclear Engineering I . . . . .	4
2.237 Nuclear Engineering II . . . . .	4
2.258 Gas Dynamics . . . . .	4
2.260 Heat and Mass Transfer . . . . .	4
2.817 Strain Gauge Techniques . . . . .	2
2.818 Photoelasticity . . . . .	2
2.847 Dynamics I . . . . .	2
2.848 Dynamics II . . . . .	2

The following undergraduate courses which are given in the daytime, may be elected by graduate students for graduate credit subject to the credit hour restrictions listed above.

**2.214 Experimental Stress Analysis** (4 q.h. credits)

Embodies the material in 2.817, Strain Gauge Techniques and 2.818, Photoelasticity. *Prep. Admission to the Graduate School of Engineering.*

Not offered 1976-77, 1977-78

**2.232 Engineering Materials** (4 q.h. credits)

Covers thermodynamics of materials; phase equilibria ternary systems; reactions with environment, i.e. kinetics, oxidation, corrosion, etc.; materials design criteria and materials engineering case studies. *Prep. Admission to the Graduate School of Engineering.* Offered spring quarter

**2.233 Thermodynamics of Propulsion** (4 q.h. credits)

Application of the physical principles of thermodynamics, fluid mechanics and plasmas to the prediction of the behavior of propulsion devices; airbreathing engines and rocket engines with applications to show how physical laws describe and limit performance of particular devices. *Prep. Admission to the Graduate School of Engineering.* Offered 1976-77, fall and winter quarters

**2.235 Statistical Thermodynamics** (4 q.h. credits)

Statistical thermodynamics approaches the study of thermodynamic equilibrium by regarding a system as a collection of particles to which the principles of either classical or quantum mechanics are presumed to apply; the statistical hypotheses of Boltzmann, Bose-Einstein, and Fermi-Dirac with emphasis on the properties of assemblies of independent particles; applications will be made to the study of gaseous systems, the Einstein and Debye theories of the specific heats of solids and the electron gas in a metal. *Prep. Admission to the Graduate School of Engineering.*

Not offered 1976-77, 1977-78

**2.236 Nuclear Engineering I** (4 q.h. credits)

Study of Nuclear Physics emphasizing atomic and nuclear structure, radioactive decay, and nuclear reactions with particular attention to fusion and fission; health physics, nuclear instrumentation, and the production and uses of radio-active isotopes; comparison of thermal, fast, and breeder reactor types; discussion of neutron interactions and slowing down; four-factor formula and the diffusion equation developed and applied to one-group theory for bare and reflected thermal reactors; energy production and distribution within the core; flux shaping. Not open to students who have completed 2.942, 2.943, and 2.944. *Prep. Admission to the Graduate School of Engineering.*

Offered fall and winter quarters

**2.237 Nuclear Engineering II** (4 q.h. credits)

Development of two-group theory for thermal reactors; the physics and safety of fast reactors; effect of reactivity change, either intentional or accidental, changes due to temperature; fission product buildup, xenon buildup after shutdown, and fuel depletion; reactor design considerations including the interrelationship of reactor physics, reactor engineering (physical design heat transfer, etc.), reactor materials and economics; control and distribution of power; fuel cycle management. Not offered to students who have completed 2.942, 2.943, and 2.944. *Prep. Admission to the Graduate School of Engineering.*

Offered spring quarter

**2.258 Gas Dynamics**

This course continues the study of fluid mechanics with emphasis on compressibility phenomena. The concept of sound speed is introduced and attention is devoted to one-dimensional steady flows. The effects of area change, friction, and heat transfer are considered, including the study of normal shock waves and the behavior of nozzles and diffusers. *Prep. Admission to the Graduate School of Engineering.*

Offered spring quarter

**2.260 Heat and Mass Transfer (4 q.h. credits)**

Review of heat, mass, and momentum transfer analogies; rate equations; conduction problems in steady-state and transient-state for both heat and mass transfer with various constant and fluctuating boundary conditions in rectangular, cylindrical, and spherical coordinates solved by formal mathematics, difference (relaxation) techniques and methods of analogy; thermal stresses induced by non-uniform temperature distributions; heat transfer at high velocity and in rarefied gases; boiling heat transfer at temperature extremes, with forced and natural convection; phase change in bulk stagnant systems. *Prep. Admission to the Graduate School of Engineering.* Offered spring quarter

*The following are graduate courses which carry two quarter hours of credit unless otherwise noted. Courses carrying four quarter hours of credit are day courses. Seminar and thesis may have varying credits established by the department at the time of registration. Not all courses are offered every year. Refer to the Graduate School of Engineering circular issued about July 1 each year for the courses to be offered in the new academic year and the times at which they are scheduled to meet.*

**2.804 Theory of Elasticity I**

Analysis of Cartesian tensors using indicial notation. Stress and strain concepts; point stress and strain; relation to tensor concepts. Governing equations for the determination of stress and displacement distributions in an elastic solid. *Prep. Admission to the Graduate School of Engineering.* Offered fall quarter

**2.805 Theory of Elasticity II**

Exact solutions to the governing equations; plane stress and strain problems in rectangular and polar coordinates including thermal stress; torsion of prismatic and axially symmetric bars; bending of thin flat rectangular and circular plates. *Prep. 2.801, Continuum Mechanics or 2.804, Theory of Elasticity I.* Offered winter quarter

**2.806 Theory of Elasticity III**

Approximate solutions for stress and displacement distributions in elastic solids; discrete solutions using finite difference and finite element methods; energy principles and the calculus of variations; relation of energy principles to the finite element method; use of energy principles to obtain approximate continuous solutions. *Prep. 2.805, Theory of Elasticity II.* Offered spring quarter

**2.809 Plasticity and Creep**

Types of deformation, elasticity, plasticity, creep, mechanical equation of state, plastic flow under multi-axial stress, and elastic creep. Relationship of comparatively simple laboratory material tests to more complex service conditions will be emphasized. *Prep. A recent introductory materials course.*

Offered 1976-77, spring quarter

**2.810 Advanced Mechanics of Materials I**

Review of fundamental stress and deformation concepts; strain energy density; theories of failure. Theorem of virtual work. Non-symmetrical bending. Introduction to variational techniques with application to beams and frames. *Prep. Admission to the Graduate School of Engineering.* Offered fall quarter

**2.811 Advanced Mechanics of Materials II**

Analysis of statically indeterminate beams, frames and rings; combined Rayleigh-Ritz Fourier series approach; beams on elastic foundation; stability analysis of beams by exact and approximate methods. *Prep. 2.810, Advanced Mechanics of Materials I.*

Offered winter quarter

**2.813 Advanced Mechanics of Materials III**

Bending and buckling of thin plates. Introduction to the Finite Element Method. Other selected topics may include simple problems in viscoelasticity and plasticity, depending on class needs. *Prep. 2.811, Advanced Mechanics of Materials II.*

Offered spring quarter

**2.815 Plates and Shells**

Bending of plates with various shapes, loads, and supports. Large deflection of plates. Membrane theory of shells. Analysis of cylindrical shells. General theory of thin elastic shells. Shells of revolution. *Prep. 2.806, Theory of Elasticity.*

Offered 1977-78, spring quarter

**2.817 Strain Gauge Techniques**

Theory and application of mechanical and electrical strain gauges. Installation, instrumentation, and circuitry of gauge set-ups for transducer use and experimental stress analysis. Use of brittle coatings in experimental stress analysis. *Prep. Admission to Graduate School of Engineering. See course 2.214.*

Not offered 1976-77, 1977-78

**2.818 Photoelasticity**

Theory and practice of photoelastic methods as applied to classical experimental stress analysis of models and as modified for use in photoelastic coatings. *Prep. Admission to Graduate School of Engineering. See course 2.214.*

Not offered 1976-77, 1977-78

**2.819 Fluid Dynamics I**

Discussion of a number of kinematic concepts important in the area of fluid dynamics including deformation rate, vorticity, circulation, and the equation of continuity. *Prep. Admission to the Graduate School of Engineering.* Offered fall quarter

**2.820 Fluid Dynamics II**

Description of the state of stress in a fluid; derivation of the Navier-Stokes equation and the energy equation; consideration of appropriate boundary conditions; study of some aspects of inviscid motion. *Prep. 2.819, Fluid Dynamics I.*

Offered winter quarter

**2.821 Fluid Dynamics III**

Study of viscous fluids of uniform constant density; exact solutions of the governing equations; approximate theories appropriate for flows at low and high Reynolds numbers, respectively. *Prep. 2.820, Fluid Dynamics II.* Offered spring quarter

**2.823 Advanced Gas Dynamics**

The consequences of fluid compressibility are studied. Shock waves and the theory of characteristics are discussed with specific consideration given to two-dimensional steady flows and one-dimensional unsteady flows. *Prep. 2.820, Fluid Dynamics.*

Offered 1977-78, fall quarter

**2.824 Advanced Gas Dynamics**

This course continues the subject matter of 2.823. Additional topics may include axially-symmetric steady flow, small-perturbation theory, similarity rules, the hodograph method, or some aspects of physical acoustics. *Prep. 2.823, Advanced Gas Dynamics*  
Offered 1977-78, winter quarter

**2.826 Math. Methods for Mechanical Engineers I**

Bessel and Legendre functions; boundary-value problems and series of orthogonal functions. Partial differential equations and applications to heat transfer fluid flow, vibrations and wave propagation. *Prep. Admission to Graduate School of Engineering.*  
Offered fall & winter quarters

**2.827 Math. Methods for Mechanical Engineers II**

Functions of a complex variable; Laurent series and singularities; residues and contour integration; conformal mapping and application; introduction to complex transforms. *Prep. Admission to Graduate School of Engineering.*  
Offered fall, winter, spring quarters

**2.828 Mathematical Methods for Mechanical Engineers III**

Matrices and linear equations. Variational calculus and applications. Approximate methods of engineering analysis. Selected topics of current interest. *Prep. 2.826 and 2.827, Math. Methods for Mechanical Engineers I and II.*  
Offered 1976-77, spring quarter

**2.829 Engineering Fracture Mechanics III**

Application of fracture mechanics to fatigue, strain energy density criteria for fracture, arrest criteria. "Work of Fracture" specimen. Application of fracture mechanics to structural analysis. Effect of anisotropy in fracture mechanics. Fracture dynamics, dynamic fracture toughness, strain rate effects. Micro-second fracture phenomenon and criteria, spall, Butcher-Tuler criterion, NAG model. Residual strength, design approaches will be emphasized. *Prep. 2.839, Engineering Fracture Mechanics II.*  
Offered 1977-78, spring quarter

**2.838 Engineering Fracture Mechanics I**

Fundamentals of brittle fracture; theoretical strength, micro/macro fracture characteristic, Inglis-Griffith theory, applicability of same. Linear elastic fracture mechanics; Orowan/Irwin extension to metals, effective surface tension and relation to fracture toughness, plastic zone size correction; geometry effects on fracture toughness; plane strain/plane stress fracture toughness, thickness effects. *Prep. Admission to the Graduate School of Engineering.*  
Offered fall quarter

**2.839 Engineering Fracture Mechanics II**

Experimental determination of fracture toughness; slow crack growth "popin", arrest, R-G curves, compliance techniques for determining elastic energy release rate. Alternate fracture toughness concepts; resistance curve, crack opening displacement, the J integral. Application of fracture mechanics to fatigue. Design methods to minimize risks of catastrophic failure will be emphasized. *Prep. 2.838, Engineering Fracture Mechanics I.*  
Offered winter quarter

**2.840 Finite Element Analysis Methods**

Introduction to the finite element method of numerical analysis; applications in solid mechanics include direct methods, energy approaches and weighted residuals; for-

mulation of simple element stiffness matrices and assembly in one and two dimensions; solids of revolution; brief discussion of complex elements used in large computer programs. Various examples of existing programs to be taken from statics, dynamics, plasticity and heat transfer. *Prep. 2.802, Continuum Mechanics or permission of instructor.* Offered spring quarter

### **2.841 Vibration Theory and Applications**

Modeling of vibratory systems; one degree of freedom systems (determination of equations of motion using free-body and energy methods); forced and free vibrations through two degrees of freedom; Laplace transformation techniques; phase-plane diagrams for undamped forced vibrations and Coulomb damping. *Prep. Admission to the Graduate School of Engineering.* Offered fall quarter

### **2.842 Vibration Theory and Applications**

Multiple degrees of freedom; free and forced vibrations with or without damping, extensional and torsional oscillation, frequency equation, energy methods of solution. *Prep. 2.841, Vibration Theory and Applications or 2.861, Systems Engineering.* Offered winter quarter

### **2.843 Vibration Theory and Applications**

Systems with distributed mass and stiffness; shock and impact; vibrations of beams and related structures; nonlinear and random vibrations. *Prep. 2.842, Vibration Theory and Applications.* Offered spring quarter

### **2.845 Shock, Vibration, and Noise Control**

Theoretical and practical considerations pertinent to the design and protection of structures and equipment subject to severe environments of transient shock, steady state vibration, random vibration, and acoustic noise. *Prep. 2.843, Vibration Theory and Applications.* Offered 1977-78, spring quarter

### **2.846 Non-Linear Vibrations**

Studies of various non-linear problems and the techniques used in solving them. Symmetrical and unsymmetrical systems. The Van der Pol-Kryloff-Bogoliuboff method as well as others will be discussed. *Prep. 2.843, Vibration Theory and Applications.* Offered 1976-77, spring quarter

### **2.847 Dynamics I**

Application of fundamental laws of motion. Transformations of coordinate systems, kinematics of a particle using translating or rotating axis, LaGrange equations, space dynamics. *Prep. Admission to the Graduate School of Engineering.* See course 2.270. Not offered 1976-77, 1977-78

### **2.848 Dynamics II**

Dynamics of rigid bodies, moments of inertia in three dimensions, Euler's Equations, includes gyroscopic motion. *Prep. 2.847, Dynamics I.* See course 2.270. Not offered 1976-77, 1977-78

### **2.849 Automatic Control Engineering**

Concepts of feedback control; formulation of equations, transfer functions, and block diagrams representing components and systems; linearization; Laplace transformation; stability. *Prep. Admission to the Graduate School of Engineering.* Offered fall quarter

**2.850 Automatic Control Engineering**

Study of control action; analysis and design by use of root-locus and frequency-domain techniques. *Prep. 2.849, Automatic Control Engineering.*

Offered winter quarter

**2.851 Automatic Control Engineering**

Further consideration of linear systems including compensation methods and multiple-inputs. Techniques for the treatment of non-linear systems. *Prep. 2.850, Automatic Control Engineering.*

Offered spring quarter

**2.853 Fundamentals of Instrumentation**

Theoretical principles underlying the design and operation of instruments for measurement and/or control. Analysis of stimulus-response relations. Industrial instruments for measurement and control, including those based on pneumatic and electrical systems. *Prep. Bachelor of Science degree.*

Offered fall quarter

**2.854 Industrial Process Control**

Fundamental principles involved in automatic control of industrial processes. Economic considerations. Application of control instruments to obtain automatic control of temperature, pressure, fluid flow, liquid level, humidity, pH. *Prep. 2.853, Fundamentals of Instrumentation.*

Offered winter quarter

**2.870 Ocean Engineering I**

Extent of the ocean in general with its physical and chemical properties; emphasis on the three-dimensional temperature distribution with time as a variable; the salinity and its variation in oceanic space and time; the density of the ocean and its stability; temperature-salinity relationships and their connection with mixing processes with large water masses; evaporation and water budget of the earth, and ice in the ocean. *Prep. Admission to the Graduate School of Engineering.*

Offered fall quarter

**2.871 Ocean Engineering II**

Geophysical structure of the sea; forces and their relation to the structure of the ocean; ocean statics, oceanic kinematics; theory of ocean currents in a homogeneous and non-homogeneous ocean; strait currents; effect of wind; the mass field and density current; fundamental principles of oceanic circulation in the troposphere and stratosphere. *Prep. 2.870, Ocean Engineering I.*

Offered winter quarter

**2.873 Geophysical Engineering**

Theory of basic geophysical methods, seismology, magnetics, gravity, and electromagnetic potential relating to ocean research and exploration with emphasis on theory, data processing, computer applications; interpretation of data and their applications; instrument systems; survey procedures; profiling; surface ship systems applications and deep submersible applications. *Prep. Admission to the Graduate School of Engineering.*

Not offered 1976-77, 1977-78

**2.874 Ocean Measurements**

Instrument design; theory application for physical and chemical properties; bathymetry; temperature, velocity and geophysical aspects of seismic, gravity, magnetic, and electromagnetic methods. *Prep. 2.873, Geophysical Engineering.*

Not offered 1976-77, 1977-78

**2.901 Advanced Thermodynamics**

A critical examination of equilibrium thermodynamics from a rigorous viewpoint emphasizing fundamental concepts including: equilibrium, heat, and work; the first and second law of thermodynamics; energy; heat engines, simple systems, and open systems. *Prep. Admission to the Graduate School of Engineering.*

Offered fall quarter

**2.902 Advanced Thermodynamics**

Continuation of 2.901 including: examination of temperature scales; entropy and availability; the phase rule, single component systems; thermodynamic relations. Consideration is also given to the ideal gas; chemical potential and thermodynamics of ideal gas mixtures. *Prep. 2.901, Advanced Thermodynamics.*

Offered winter quarter

**2.903 Advanced Thermodynamics (4 q.h. credits)**

Embodies the material in 2.901 and 2.902 Advanced Thermodynamics. *Prep. Admission to the Graduate School of Engineering.*

Offered winter quarter

**2.904 Special Topics in Advanced Thermodynamics**

Selected subjects of current interest in general thermodynamics including: chemical reactions; the law of stable equilibrium, normal and special systems, and the third law. Detailed analysis of the statistics of ensembles is also covered to emphasize the relationship between thermodynamics and statistical mechanics. *Prep. 2.902, Advanced Thermodynamics.*

Offered spring quarter

**2.905 Cryogenic Engineering**

Designed to provide a familiarity with the general field of cryogenics, some of the principal uses of cryogenics, and the ways of obtaining and preserving an environment at a low temperature. Refrigeration, cycle analysis, heat exchanger design, insulation systems, properties of materials, instrumentation problems and applications. Problems will be assigned typical of those which are encountered in the field and laboratory. *Prep. Admission to the Graduate School of Engineering.*

Offered fall quarter

**2.906 Cryogenic Engineering**

Continuation of 2.905, Cryogenic Engineering. *Prep. 2.905, Cryogenic Engineering.*

Offered winter quarter

**2.907 Cryogenic Engineering**

Application of Cryogenic Engineering Principles to the design of integrated systems. *Prep. 2.906, Cryogenic Engineering.*

Offered spring quarter

**2.910 Conduction Heat Transfer**

Basic laws of heat transfer; analytical solutions of single and multidimensional systems in steady and transient states with and without heat sources in cartesian, cylindrical, and spherical coordinates; chart solutions; Newtonian method, steady state and transient numerical analysis; generalized fin equation. *Prep. Elements of Heat Transfer.*

Offered fall quarter

**2.911 Convection Heat Transfer**

Fundamentals of convection; Reynolds, Prandtl, and Nusselt numbers; elements of boundary layer theory; free and forced convection in ducts and over flat plates solved



by dimensional, exact mathematical and approximate integral analyses for both laminar and turbulent flows; Reynolds analogy and Prandtl's modification; boiling and condensation; heat transfer in high speed flow; heat exchangers. *Prep. Elements of Heat Transfer.* Offered winter quarter

### **2.913 Radiation Heat Transfer**

Basic laws of thermal radiation; Planck black body radiation; Kirchhoff's laws; Stefan-Boltzmann law; radiation properties of surfaces; radiative transfer between gray and non-gray diffuse and specular surfaces separated by transparent media; radiation properties of gases; radiative transfer through absorbing, emitting, and scattering media; radiative transfer in the presence of conduction and convective heat transfer. *Prep. Elements of Heat Transfer.* Offered spring quarter

### **2.920 Direct Energy Conversion**

The fundamental processes of direct energy conversion and their application to the design and operation of magnetohydrodynamic power generators, thermionic converters, and fuel cells. *Prep. Admission to the Graduate School of Engineering.* Offered 1976-77, fall quarter

### **2.921 Direct Energy Conversion**

Continuation of 2.920. *Prep. 2.920, Direct Energy Conversion.*

Offered 1976-77, winter quarter

### **2.923 Special Topics in Direct Energy Conversion**

Irreversible thermodynamics. Unified theory of energy conversion. *Prep. 2.921, Direct Energy Conversion.* Offered 1976-77, spring quarter

### **2.930 Pumps**

Deals mainly with centrifugal pumps, with brief references to other types; flow of fluids in pipes and conduits, system curves, pump head velocity diagrams and head development, efficiency; specific speed, net positive suction head, cavitation; affinity laws, selection of pumps to suit various operating conditions and methods of driving, parallel operation; automatic operation, types of construction and materials used, methods of priming centrifugal pumps, pumping of chemicals, oils, and sludges, special problems of pump installation and operation, water hammer in pump discharge lines. *Prep. Hydraulics.* Offered 1976-77, spring quarter

### **2.931 Fans and Blowers**

Flow of air in pipes and ducts, fan characteristics and laws, various types of fan wheels, inlet and outlet connections, fan capacity control, fan selection and testing. Compression of air and gases, flow in pipes, head-on blowers, performance curves, effect of changes in speed and inlet conditions, construction, regulation, selection, installation, and testing. Axial flow fans and blowers. Positive pressure blowers. *Prep. Thermodynamics.* Offered 1977-78, spring quarter

### **2.932 Pollution Problems from Combustion Processes I**

A major portion of the energy produced in the United States depends upon combustion processes including energy produced in electrical power generation, motor vehicles, and aircraft. Combustion processes have contributed to air, water, and noise pollution problems. This course examines combustion systems in detail to determine sources of pollution problems and to designate methods by which these problems can be met. (Continued on next page)

An overview of the energy production by electrical power generation systems, motor vehicles, and aircraft so that the magnitude of the contribution of these systems to the pollution problem can be assessed. These systems will be described as heat engines. A thermodynamic analysis will be made to evaluate their efficiencies. The correlation between heat engine efficiency and its effect on pollution problems will be discussed. *Prep. Admission to the Graduate School of Engineering.*

Offered 1977-78, fall quarter

### **2.933 Pollution Problems from Combustion Processes II**

Basic principles of combustion processes are developed for an understanding of the emission products as a function of system operating conditions. Topics of thermochemistry, chemical equilibrium, chemical kinetics, conservation of energy, equation of motion, chemistry of hydrocarbons, and theories of combustion processes are presented toward this end. *Prep. 2.932, Pollution Problems from Combustion Processes I.*

Offered 1977-78, winter quarter

### **2.934 Pollution Problems from Combustion Processes III**

Combustion systems include physical processes as well as chemical. Physical processes of fuel injection, atomization, vaporization, and mixing, and their relation to combustion systems, will be discussed. Details of operation of electrical power generation systems, automotive engines, and aircraft engines are examined to identify sources of pollution and designate methods for pollution control. *Prep. 2.933, Pollution Problems from Combustion Processes II.*

Offered 1977-78, spring quarter

### **2.935 Power Plant Design**

Study of the thermodynamic cycles, equipment, and processes of the various types of power plants, with emphasis on modern central station practice. *Prep. Thermodynamics.*

Offered fall quarter

### **2.936 Power Plant Design**

Continuation of 2.935, Power Plant Design. *Prep. 2.935.*

Offered winter quarter

### **2.938 Power Generation Economics**

Integrated study of the various factors affecting cost of power generation, including the effects of fuels availability and pricing, equipment selection and plant efficiency, siting and financial considerations. *Prep. 2.935.*

Offered spring quarter

### **2.942 Nuclear Engineering I**

Topics include: growth of nuclear power industry; study of nuclear physics emphasizing atomic and nuclear structure, radioactive decay, and nuclear reactions with particular attention to fission and fusion; radiation health physics; principles of shielding; nuclear instrumentation; production and application of radioisotopes; neutron interactions and slowing down theory; neutron activation analysis. (Not open to students who have completed 2.236 & 2.237.) *Prep. Admission to Graduate School of Engineering.*

Offered fall quarter

### **2.943 Nuclear Engineering II**

Comparison of thermal, fast, and breeder reactors; four factor formula and the neutron diffusion equation; one-group, modified one-group, two-group and multi-group theory; bare and reflected thermal reactors; energy production and distribution within core; flux shaping; transient reactor behavior and control; factors affecting

reactivity including temperature, pressure, void formation, fission product accumulation, fuel depletion and fuel breeding; Xenon buildup after shutdown. (Not open to students who have completed 2.236 & 2.237.) *Prep.* 2.942. Offered winter quarter

### **2.944 Nuclear Engineering III**

Reactor design considerations; interrelationship of reactor physics, control, engineering, materials, safety, and fuel cycle management; reactor types; radiation damage and reactor materials; nuclear fuels; reactor heat transfer; economics of nuclear power; environmental effects. (Not open to students who have completed 2.236 & 2.237.) *Prep.* 2.943. Offered spring quarter

### **2.953 Advanced Physical Metallurgy III**

The kinetics of phase transformations in metals. Topics include kinetic theory, empirical kinetics, diffusion in metals, nucleation, diffusional growth, martensitic transformations. *Prep.* A recent introductory material science course. Offered 1976-77, spring quarter

### **2.954 Advanced Physical Metallurgy I**

Dislocation theory; including such topics as dislocation stress fields, self energy, velocity, interactions mechanisms, image forces, and theories of yielding. *Prep.* A recent introductory material science course. Offered 1976-77, fall quarter

### **2.956 Advanced Physical Metallurgy II**

Mechanical behavior of metals. Application of dislocation theory to micro-plasticity, strain hardening, strengthening mechanisms and creep. *Prep.* 2.954, *Advanced Physical Metallurgy I*. Offered 1976-77, winter quarter

### **2.960 Thermodynamics of Materials I**

Basic metallurgical thermodynamics encompassing first, second, and third laws, entropy, enthalpy, and free energy. *Prep.* *Engineering Materials*. Offered 1977-78, fall quarter

### **2.961 Thermodynamics of Materials II**

Continuation of 2.960 with emphasis on solutions, activity, activity coefficients, the phase rule and applications to some metallurgical problems. *Prep.* 2.960, *Thermodynamics of Materials I*. Offered 1977-78, winter quarter

### **2.963 Thermodynamics of Materials III**

The application of metallurgical thermodynamics to various process metallurgical problems, i.e., gas-solid systems, etc., plus kinetics of reactions and dynamics systems analysis. *Prep.* 2.960 or 2.961, *Thermodynamics of Materials I or II*. Offered 1977-78, spring quarter

### **2.965 Physical Ceramics**

Introduction to ceramic fabrication processes. Characteristic of vitreous and crystalline solids, structural imperfections, and atomic mobility. Phase equilibria, nucleation, crystal growth, solid-state reactions, non-equilibrium phases, and effects on the resulting microstructure of ceramics. *Prep.* A recent introductory material science course, *Physical Chemistry or Solid State Physics*. Offered 1976-77, fall quarter

**2.966 Physical Ceramics**

Discussion of effects of composition and microstructure on the thermal, mechanical, optical, electrical, and magnetic properties of ceramic materials. *Prep. 2.965, Physical Ceramics* Offered 1976-77, winter quarter

**2.970 Material Science and Engineering I**

Principles underlying the structure and properties of solid materials. The relationships of these principles to the properties and to applications in structures and devices. Both macroscopic-phenomenological and electronic-molecular approaches will be used. Materials will include metals and alloys, semiconductors, and dielectrics. Typical subjects are atomic and electronic structures, ordering, nucleation, crystal growth, and thermal properties. *Prep. A recent introductory material science course.* Offered 1977-78, fall quarter

**2.971 Material Science and Engineering II**

Continuation of 2.970 into additional topics such as thermal, electric, magnetic, and optical properties; applications of solid-state phenomena to achieve functions embodied in transducers, filters, amplifiers, energy converters, and so forth. *Prep. 2.970, Material Science and Engineering.* Offered 1977-78, winter quarter

**2.972 Materials Science and Engineering III**

Continuation of 2.971 plus a discussion of various special topics that will vary from year to year. Examples are: metastable phases and thin films. *Prep. 2.971, Materials Science and Engineering II.* Offered 1977-78, spring quarter

**2.975 Introduction to Diffraction Methods in Materials Science**

General principles of the diffraction of short wave length radiations; such as x-ray, electrons, and thermal neutrons by materials are studied with emphasis on the understanding of the similarities and differences of the different radiations when applied to the study of the structures of crystalline and non-crystalline materials. *Prep. A recent introductory material science course.* Offered 1977-78, fall quarter

**2.976 Diffraction Methods in Materials Science**

Continuation of 2.975 with emphasis on the experimental methods and applications. This includes: choice of radiation, introduction to instrumentation, sample preparation, methods of detection and recording of the diffracted radiation, analysis, interpretation and use of the results. *Prep. 2.975, Introduction to Diffraction Methods in Materials Science.* Offered 1977-78, winter quarter

**2.982 Metallurgical Systems for Structural Applications I**

Several important metallurgical and material systems are studied with emphasis on categorizing their utility and explaining sources of their strength, fracture toughness, fatigue strength and creep resistance. This course deals in a general way with the metallurgical and mechanical aspects of the properties listed. *Prep. An undergraduate materials science or metallurgy course.* Offered 1977-78, winter quarter

**2.983 Metallurgical Systems for Structural Applications II**

The application of the principles developed in 2.982 to the following specific metallurgical and materials systems: high strength steels, aluminum alloys, titanium alloys, superalloys, polymeric materials, ceramic materials, fiber composites. *Prep. 2.982, Metallurgical Systems for Structural Applications I.*

Offered 1977-78, spring quarter

**2.985 Powder Metallurgy**

Powder characteristics and methods of manufacture. Powder pressing: packing, interparticle bonding, effects of pressure. Principles of sintering. Characteristics and properties of products made from powdered materials. *Prep. A recent introductory material science course.* Offered 1976-77, spring quarter

**2.986 Behavior of Materials Under High Pressures I**

Historical development of high pressure research in brief. Basic design principles of static high pressure apparatus; use of gases, liquids and solids as pressure transmitting media; introduction to principles of shock wave method; equations of state of solids and their measurement at high pressures and at ultra high pressures. *Prep. Admission to the Graduate School of Engineering.* Offered 1976-77, fall quarter

**2.987 Behavior of Materials Under High Pressures II**

Crystal structure transformation, electronic transitions and insulator-metal transitions under pressure; electrical and magnetic properties and deformations of solids under pressure; geological phenomena related to high pressures; current developments in high pressures. *Prep. 2.986, Behavior of Materials Under High Pressure I.* Offered 1976-77, winter quarter

**2.990 Mechanical Engineering Seminar I (1 q.h. credit)**

Introduce first year graduate students to graduate research and the mechanics of undertaking a Master's thesis; research opportunities in the various mechanical engineering disciplines; interdisciplinary research opportunities; definition of a research problem; the role of a thesis advisor; methods of conducting research; writing a Master's thesis. *Prep. Admission to Master of Science Program.*

Offered yearly, fall quarter

**2.991 Thesis (Master's Degree)**

Analytical and/or experimental work conducted under the auspices of the department. Open to day students only. *Prep. Admission to Master of Science Program.*

Offered yearly, all quarters

**2.992 Special Problems in Mechanical Engineering**

Theoretical or experimental work under individual faculty supervision. *Prep. Consent of department chairman.*

Offered yearly, all quarters

**2.993 Special Topics in Mechanical Engineering**

Topics of interest to the staff member conducting this class are presented for advanced study. *Prep. Permission of department staff.*

Offered yearly, all quarters

**2.994 Doctoral Reading**

Material approved by the candidate's adviser (only S or F grades will be assigned for this course). *Prep. Passing of Ph.D. Qualifying Exam.*

Offered yearly, all quarters

**2.995 Dissertation (Ph.D. Degree)**

Theoretical and experimental work conducted under the supervision of the department. Open to day students only. *Prep. Admission to the Doctoral Program in Mechanical Engineering.*

Offered yearly, all quarters

**2.996 Dissertation (Mechanical Engineer Degree)**

Analytical and/or experimental work conducted under the auspices of the department. Open to day students only. *Prep. Admission to the Mechanical Engineer Degree Program.* Offered yearly, all quarters

**2.998 Mechanical Engineering Seminar II**

Graduate students in their final Master's year will present current results of their thesis work. Non-thesis students will present reports on scientific work that they have pursued in the past or have studied in technical literature. *Prep. 2.990, Mechanical Engineering Seminar I.* Offered yearly, winter quarter

**ELECTRICAL ENGINEERING****3.800 Plasma Engineering I**

Behavior, diagnostics, and generation of plasma and gas discharges; emphasis on the engineering and experimental point of view rather than on a rigorous theoretical treatment. Current literature on a variety of plasma engineering applications will be introduced throughout the course. First quarter topics include: dynamics of charged particles in static electric and magnetic fields, E and M wave-plasma interactions, Infinite and Finite Media, elastic and inelastic collisions. *Prep. Bachelor of Science degree in Electrical Engineering or Physics or 3.977, Precis of Modern Electrical Engineering III.* Fall quarter

**3.801 Plasma Engineering II**

Plasma Electrodynamics. An introduction to linear and nonlinear response functions. The Fluid Models of plasma are developed and are applied to applications in MHD and stability of various thermonuclear confinement schemes. *Prep. 3.800, Plasma Eng. I.* Fall quarter

**3.802 Plasma Engineering III**

The Kinetic theory of plasma is developed. Emphasis will be on the collisionless or Vlasov approximations. The theory will be applied to the study of microinstabilities in plasma. *Prep. 3.801, Plasma Eng. II.* Winter quarter

**3.803 Plasma Engineering (4 q.h. credits)**

Offered days. Includes the material given in 3.800 and 3.801 — Plasma Engineering I and II. *Prep. Bachelor of Science degree in Electrical Engineering or Physics or 3.977, Precis of Modern Electrical Engineering III.* Winter quarter

**3.806 Lasers I**

Review of basic optical principles and atomic physics; introduction to optical coherence; models for the interaction of electromagnetic radiation with matter; a general description of lasers is given. *Prep. Bachelor of Science degree in Engineering or Science.* Fall quarter

**3.807 Lasers II**

Laser threshold and rate equations; elementary resonator theory and fabrication; giant pulse operation; specific solid-state, liquid, and gas lasers; and laser systems. *Prep. 3.806, Lasers I.* Winter quarter

**3.808 Laser Applications**

Applications of lasers and laser systems for a variety of engineering and basic science disciplines; specific laser optoelectronic devices. *Prep. 3.807, Lasers II or equivalent.* Spring quarter

**3.810 Thermonuclear Fusion Energetics I**

Application of the concepts developed in 3.800 and 3.801 to the problem of thermonuclear plasmas. Emphasis will be on magnetic confinement schemes. Both open (mirror machines) and closed (toroidal confinement machines) systems will be discussed. *Prep. 3.801, Plasma Eng. II.* Fall quarter

**3.811 Thermonuclear Fusion Energetics II**

Continuation of magnetic confinement schemes. Trapped particle instabilities and anomalous transport effects will be discussed. Introduction to interfacial confinement (laser fusion). *Prep. 3.810, Thermonuclear Fusion Energetics I.* Winter quarter

**3.812 Thermonuclear Fusion Energetics III**

Introduction to Microinstabilities associated with laser fusion devices. Introduction to computer modeling of plasmas. Discussion of recent advances in thermonuclear plasma generation by relativistic electron beams. *Prep. 3.802, Plasma Engineering III; 3.811, Thermonuclear Fusion Energetics II.* Spring quarter

**3.817 Physical Acoustics**

Radiation, transmission, and absorption phenomena of plane, cylindrical, and spherical waves. Distributed-system analogies, simple sources, dipole sources, radiation impedance, and radiation patterns. Diffraction theory and ray acoustics. The effects of inhomogeneities and of dissipation processes on sound transmission. *Prep. Bachelor of Science degree in Engineering or Science.* Fall quarter

**3.818 Aeroacoustics**

Theory of acoustic transducers, such as microphones, loudspeakers, and horns. Mechanism of speech production and the acoustic properties of the vocal system. Mechanism of hearing and the acoustic properties of the ear. Noise and noise control in our environment. Room acoustics. *Prep. 3.817, Physical Acoustics.* Winter quarter

**3.819 Underwater Sound**

Sonar equations. Properties of transducer arrays. Generation, propagation, and reception of underwater sound. The noise background. Detection of signals in noise and reverberation. *Prep. 3.818, Aeroacoustics.* Spring quarter

**3.823 Mathematical Methods in Electrical Engineering (4 q.h. credits)**

This course, offered days, embodies the material in 3.8C4 and 3.8C5, Mathematical Methods in Electrical Engineering III and IV. (Not open to Northeastern graduates who have completed 3.293). *Prep. Bachelor of Science degree in Engineering.* Fall and winter quarters

**3.824 Linear Systems Analysis I (Fundamental Precepts)**

A study of the basic concepts of time and frequency domain analysis including differential equations and systems of simultaneous first order equations, integral solutions including superposition and convolution integrals and Green's function solutions; the application of complex variable theory to the study of Laplace and z-

transforms; the application of matrix theory to systems analysis. *Prep. Bachelor of Science degree in Electrical Engineering or 3.975, Precs of Modern Electrical Engineering I. Recommended are courses 3.8C4 and 3.8C5 or their equivalent.*

Fall, winter, and spring quarters

### **3.825 Linear Systems Analysis II (State Variable Representation of Systems)**

A continuation of program begun with 3.824. Introduction to state variable analysis of continuous and discrete systems. Standard canonical representations. Computer simulation of systems behavior. Solution of state equations for linear time invariant systems. Analysis of transient response. *Prep. 3.824, Linear Systems Analysis I or equivalent.*

Fall, winter, and spring quarters

### **3.826 Linear Systems Analysis III (Applications of State Variable and Transform Techniques)**

A continuation of 3.825. Extensions of techniques to time varying systems. Stability and related matters. Introduction to optimization and optimal systems. Observability and controllability. Further applications to discrete as well as continuous systems. The application of digital computers to systems analysis. *Prep. 3.825, Linear Systems Analysis II.*

Winter and spring quarters

### **3.827 Linear Systems Analysis through State Variable and Transform Techniques** (4 q.h. credits)

Offered days. Includes the material given in 3.825 and 3.826, Linear Systems Analysis II and III. *Prep. Bachelor of Science degree in Electrical Engineering and 3.824, Linear Systems Analysis I or equivalent.*

Fall and winter quarters

### **3.830 Network Synthesis I-A**

Matrix circuit analysis including m-port parameter systems. Positive-real functions. Energy functions. Driving-point synthesis techniques for LC, RC, and RL networks. *Prep. Bachelor of Science degree in Electrical Engineering or 3.975, Precs of Modern Electrical Engineering I.*

Fall, winter, and spring quarters

### **3.831 Network Synthesis I-B**

Driving-point synthesis of RLC networks. Properties of two-port networks. Two-port synthesis, including the parallel ladder realization. Lattice synthesis. *Prep. 3.830, Network Synthesis I-A*

Fall, winter, and spring quarters

### **3.832 Network Synthesis I** (4 q.h. credits)

Offered days. Includes the material given in 3.830, Network Synthesis I-A and 3.831, Network Synthesis I-B. *Prep. Bachelor of Science degree in Electrical Engineering or 3.975, Precs of Modern Electrical Engineering I.*

Fall and spring quarters

### **3.833 Network Synthesis II**

Scattering, immittance, and hybrid formalisms for linear networks; state-space formulation and techniques for time-invariant and time-varying networks; introduction to passive n-port synthesis. *Prep. 3.831, Network Synthesis I-B or 3.832, Network Synthesis I.*

Fall quarter

### **3.834 Advanced Network Theory I**

General realizability of linear lumped and distributed systems; synthesis of reciprocal and non-reciprocal n-port networks; lossless microwave multi-port junctions; stabili-



ty characterizations of active networks; theory of linear active multi-port networks.  
*Prep. 3.833, Network Synthesis II.* Winter quarter

### **3.835 Advanced Network Theory II**

Interrelationship between parts of network functions; theory of optimum broadband matching; approximation methods and insertion loss synthesis; analysis and synthesis of transmission line filters and equalizers; gain-bandwidth theory of negative resistance devices including tunnel diodes, varactors, avalanche transit-time, and bulk-effect devices. *Prep. 3.834, Advanced Network Theory I.* Spring quarter

### **3.837 Introduction to Graph Theory**

Fundamentals of graph theory, including blocks, trees, connectivity, partitions, traversability, line graphs, factorization, coverings, planarity, matrices, digraphs, and enumeration problems. Selected applications of graph theory in such fields as network theory, switching theory, and computer science. *Prep. Bachelor of Science degree in Engineering or Science.* Fall quarter

### **3.838 Nonlinear Circuit Analysis I**

Numerical, graphical, and analytical methods for the solution of physical systems described by nonlinear differential equations. Geometric analysis in second-order systems. Perturbation and averaging theory. *Prep. 3.831, Network Synthesis I-B or 3.832, Network Synthesis I.* Winter quarter

### **3.839 Nonlinear Circuit Analysis II**

Linear, time-varying systems and their relationship to certain nonlinear problems. The WJKB approximation. The Hill and Mathieu Equations. Stability of nonlinear systems. Lyapunov Theory. Selected topics in nonlinear analysis according to group interest. *Prep. 3.838, Nonlinear Circuit Analysis I.* Spring quarter

### **3.840 Linear Active Circuits I**

Active networks are developed from device representation and appropriate circuit theory concepts. Topics included are application of flowgraphs and matrices to design and analysis, development of solid state device models, stability, integrated circuitry limitations and dominant pole analysis, and realization from open and short-circuit impedance concepts. These are applied to the realization, operation, and optimization of gainband-width products of wide-band amplifiers to obtain specific characteristics such as Butterworth and other functions. *Prep. Bachelor of Science degree in Electrical Engineering or 3.967, Precise of Modern Electrical Engineering II.* Fall quarter

### **3.841 Linear Active Circuits II**

The results of 3.840, Linear Active Circuits are extended to include narrowband, band pass amplifiers, and feedback amplifier concepts. The effects of feedback upon gain, impedance noise, and stability are developed from return difference and ratio viewpoints utilizing open and short-circuit loop gain concepts. Consideration is given to the synthesis of driving point and transfer functions using active filters, negative impedance converters, and other basic building blocks. *Prep. 3.840, Linear Active Circuits I.* Winter quarter

**3.842 Linear Active Circuits** (4 q.h. credits)

Offered days. Includes the material given in 3.840, Linear Active Circuits I and 3.841, Linear Active Circuits II. *Prep. Bachelor of Science degree in Electrical Engineering or 3.976, Precis of Modern Electrical Engineering II.* Fall and winter quarters

**3.843 Linear Active Circuits III**

A continuation of the material covered in Linear Active Circuits I and II. Emphasis will be placed on feedback systems, including multiloop amplifier design. These techniques will be applied to integrated circuit realizations of basic active networks. *Prep. 3.840, Linear Active Circuits I or 3.841, Linear Active Circuits II.* Spring quarter

**3.845 Active Network Synthesis**

Basic methods of active network synthesis are introduced through three commonly used approaches: feedback amplifier, negative impedance convertor, and gyrator; structures of Sallen and Key, Kuh, Linvill, Yanagisawa, Rohrer, Kinariwals, Seppess, and Calahan; consideration of the practical realization of NIC's and gyrators, standard decomposition methods and sensitivity; work of Sandberg, Larky, Newcomb, Daniels, Horowitz, and Thomas. *Prep. 3.831, Network Synthesis I-B and 3.841, Linear Active Circuits II or equivalent.* Fall quarter

**3.853 Solid State Device Theory and Practice** (4 q.h. credits)

This course meets twice weekly. On one night there is a two-hour lecture; on the other, a three-hour lab. The course carries four quarter hours of credit. A case method study of solid state devices with a laboratory tightly integrated with the classroom work. The methodology developed is fundamental to the discrete and integrated circuit technology. The classroom portion of the course is devoted to junction diode and bipolar transistor theory including the physics of achieving a given design. In the laboratory, the student designs, builds, and tests diodes and transistors to meet certain electrical characteristics. The devices achieved are seldom of commercial quality, but sufficient equipment is available in the laboratory to make practical device processing possible even for completely untrained personnel. *Prep. An undergraduate level background in electronics and semiconductor devices.* Fall quarter

**3.854 Solid State Theory and Practice** (4 q.h. credits)

The course is offered on the same basis as 3.853 and is a continuation of that course. The central topic is field effect transistors with appropriate design problems for the laboratory. *Prep. 3.853, Solid State Device Theory and Practice.* Spring quarter

**3.8G1 Characteristics and Models of Solid State Devices I**

This sequence of three courses is designed to develop real insight into the operation of a broad range of semiconductor devices. Important topics in the physics of semiconductors to provide the background necessary for device analysis are discussed. Analysis of fundamental building-block units of which devices are made including the PN junction, the ohmic contact and the Schottky barrier. Each is examined under reasonable extremes of bias and temperature to establish the electrical behavior expected from such elementary units. *Prep. Bachelor of Science degree in Electrical Engineering or equivalent.* Fall quarter

**3.8G2 Characteristics and Models of Solid State Devices II**

Detailed analysis of the bipolar transistor, metal-oxide-semiconductor interface, its influence on the behavior of real junctions, and the various realizations of the field-effect transistor. *Prep. 3.8G1, Characteristics and Models of Solid States I.*

Winter quarter

**3.8G3 Characteristics and Models of Solid State Devices III**

A continuation of the work of the previous two courses. A detailed analysis of the performance of FET's will permit a critical comparison of field effect and bipolar transistors. Solid state microwave devices; devices that are both unique to microwave applications and the relevant low-frequency elements which require somewhat different analysis at microwave frequencies. An examination of noise in semiconductor devices. *Prep. 3.8G2, Characteristics and Models of Solid State Devices II.*

Spring quarter

**3.860 Pulse Processing I**

The principles and techniques of pulse-forming and pulse-processing circuits will be developed. Pulse forming, switching and time base generators will be covered. *Prep. Bachelor of Science degree in Electrical Engineering or 3.975, 3.976, and 3.977, Precs of Modern Electrical Engineering I, II, and III.*

Winter quarter

**3.861 Pulse Processing II**

Continuation of 3.860, Pulse Processing I, to include the pulse processing circuits and the analog/digital interface techniques in radar, digital computation and data processing systems. *Prep. 3.860, Pulse Processing I.*

Spring quarter

**3.865 Radar Systems I**

Emphasis on the systems aspects of radar engineering. Topics covered include antennas; low-noise receivers; high-power transmitters; range, angle, and Doppler tracking systems; search radar systems. Mathematical descriptions are used throughout. *Prep. 3.901, Applied Probability and Stochastic Process II or 3.902, Applied Probability and Stochastic Process I.*

Fall quarter

**3.866 Radar Systems II**

Continuation of 3.865, Radar Systems I, a further consideration of systems aspects. The principles of radar detection theory; matched filter and correlation receiver design; radar ambiguity function; radar uncertainty principles; radar waveform synthesis; fundamental accuracy limits; generalized tracking problems. *Prep. 3.865, Radar Systems I.*

Winter quarter

**3.867 Radar Systems III**

Advanced topics in radar engineering including modern tracking techniques, waveform synthesis, multifunction array radar techniques, and selected topics in radar-sensing techniques and devices. *Prep. 3.866, Radar Systems II.*

Spring quarter

**3.871 Communications Systems I**

Primarily concerned with radio communication systems as used in terrestrial and space communication applications. Antenna gain, space loss, cosmic and atmospheric noise, and receiver noise as factors influencing the signal-to-noise ratio in space and satellite repeater systems; channel models are developed for over the

horizon systems utilizing ionospheric propagation and exhibiting fading and multipaths; contemporary systems are discussed from the standpoint of signal spectrum, noise power and message ambiguity as exhibited at the output of the intermediate frequency receiver. *Prep. Background in probability and Fourier analysis.*

Fall quarter

### 3.872 Communications Systems II

Primarily concerned with the theoretical aspects of analogue modulation systems used in radio and space communications. First and second threshold effects will be discussed in conjunction with signal-to-noise considerations for amplitude and angle modulated systems. Treatment of frequency feedback and phase-lock loops will be included in the discussion of frequency modulation and detection. Frequency division multiplexing will include sub-carrier pre-emphasis and comparative performance figures for SSSC/FM and FM/FM. *Prep. 3.871, Communications Systems I or 3.900, Applied Probability and Stochastic Processes A.*

Winter quarter

### 3.873 Communications Systems III

Continuation of techniques of 3.872 to cover digital modulation systems and time division multiplexing. Adaptive sampling, aliasing, and interpolation will be discussed along with PAM/FM. Pulse code modulation systems utilizing frequency and phase shifted carriers will be compared under noise conditions. Treatment will be given to the use of codes with special correlation, modulation by sequences, and phase-coherent communication. *Prep. 3.872, Communications Systems II.*

Spring quarter

### 3.875 Electromagnetic Theory I

Maxwell's equations and related electromagnetic laws and relations; basic properties of matter; electromagnetic potentials; the scalar and vector Poisson, D'Alembert, and Helmholtz equations; Green's functions; both mathematical and physical aspects of the theory and their relation to engineering applications. *Prep. Bachelor of Science degree in Electrical Engineering or 3.977, Precs of Modern Electrical Engineering III, Advanced Calculus, and Vector Analysis.*

Fall quarter

### 3.876 Electromagnetic Theory II

Basic radiation phenomenon including retarded potentials, radiation from moving charges, electromagnetic energy, and energy-related theorems. Propagation of plane waves in media with real and complex constitutive parameters. Fundamental theory of guided waves. *Prep. 3.875, Electromagnetic Theory I.*

Winter quarter

### 3.877 Electromagnetic Theory (4 q.h. credits)

Offered days. Includes the material given in 3.875 and 3.876, Electromagnetic Theory I and II. *Prep. Bachelor of Science degree in Electrical Engineering or 3.977, Precs of Modern Electrical Engineering III.*

Winter and spring quarters

### 3.878 Advanced Electromagnetic Theory I

More advanced approaches to problems in electromagnetic theory of interest to electrical engineers — for example: waveguide, antennas, diffraction, and scattering; approximation techniques for obtaining useful solutions of field theory problems including integral equation, perturbation, and variational techniques. *Prep. 3.876, Electromagnetic Theory II or 3.877, Electromagnetic Theory.*

Spring quarter

**3.879 Advanced Electromagnetic Theory II**

Special relativity and relativistic electrodynamics. Radiation from moving charges. Statistical concepts and propagation in random media. Introduction to magneto-hydrodynamics and plasma physics. *Prep. 3.878, Advanced Electromagnetic Theory I* Fall quarter

**3.880 Microwave Theory**

Propagation of electromagnetic waves on periodic structures. Propagation on a helix. Waves on electron beams. Coupled-mode theory. Traveling-wave devices. Propagation in anisotropic media. Ferrite devices. *Prep. 3.876, Electromagnetic Theory II or 3.877, Electromagnetic Theory.* Spring quarter

**3.881 Microwave Circuits I**

Review of microwave circuit theorems; scattering matrices and applications; eigenvalue problem; symmetrical and miscellaneous junctions; applications of 3-db couplers; polarizers, phase shifters and attenuators; non-reciprocal and ferrite devices. *Prep. 3.876, Electromagnetic Theory II or 3.877, Electromagnetic Theory.* Winter quarter

**3.882 Microwave Circuits II**

One-port resonant cavity; transmission cavity; analysis and synthesis of microwave filters; traveling-wave resonators; periodically loaded lines; selected microwave system considerations. *Prep. 3.881, Microwave Circuits I.* Spring quarter

**3.883 Advanced Electromagnetic Theory (4 q.h. credits)**

Offered days. Includes the material given in 3.878 and 3.879 — Advanced Electromagnetic Theory I and II. *Prep. 3.876, Electromagnetic Theory II or 3.877, Electromagnetic Theory.* Spring quarter

**3.885 Antennas and Probes in Physical and Biological Materials**

Basic theory of electromagnetic radiating structures. The application of antennas as probes to measure the geometrical and electrical properties of physical and biological materials. The use of probes to telemetric information from the human body, the measurement and effect of electromagnetic radiation on humans will be covered. *Prep. 3.876, Electromagnetic Theory II or 3.877, Electromagnetic Theory.* Spring quarter

**3.887 Three-dimensional Picture Processing and Reconstruction**

The application of computer and optical methods in finding dimensional information from pictures. Particular attention will be given to transmission pictures that arise from x-ray data, electron micrographs or from electromagnetic scattering. Classical and modern methods will be applied to the problem of making three-dimensional reconstruction from two dimensional pictures. *Prep. Bachelor of Science degree in Engineering or Science.* Spring quarter

**3.890 Electromagnetic Wave Propagation I**

Topics in wave propagation of prime importance in communications and space physics. Review of wave propagation in a homogeneous medium. Physical processes in the atmosphere. The formation and structure of the ionosphere. Basic magneto-ionic theory. Propagation of waves in a spatially varying medium. Ray theory. *Prep. 10.9N2, Advanced Mathematics or equivalent.* Winter quarter

**3.891 Electromagnetic Wave Propagation II**

Application of the theory of the oblique incidence of radio waves on the ionosphere, including the effects of the presence of the geomagnetic field, to radio communications. The interpretation of ionograms. Path prediction and field strength computations. Absorption. Top side soundings. Incoherent thermal scatter. Ionospheric irregularities and motions, and their study by space and frequency diversity techniques and other methods. *Prep. 3.890, Electromagnetic Wave Propagation I.* Spring quarter

**3.893 Digital Computer Programming I**

First quarter of a three-quarter sequence of systems programming and language processors. Topics include: machine structure, machine language, assembly language; assemblers, macros, macro-processors; searching and sorting; loaders; data structures, storage allocation; high-level languages; compilers; operating systems; management of memory, processors, devices; multiprocessing and multiprogramming. *Prep. B.S. degree in Engineering or Science and knowledge of a higher level programming language.* Fall quarter

**3.894 Digital Computer Programming II**

Continuation of 3.893. *Prep. 3.893, Digital Computer Programming I.*

Winter quarter

**3.895 Digital Computer Programming III**

Continuation of 3.894. *Prep. 3.894, Digital Computer Programming II.*

Spring quarter

**3.898 Combinatorial Mathematics**

An introductory course in applied combinatorial mathematics which treats selected topics in enumerative analysis. Particular subjects include permutations, combinations, generating functions, recurrence relations, and the principle of inclusion and exclusion. *Prep. 3.8A1, Mathematical Methods in Computer Science.*

Fall quarter

**3.899 Combinatorial Methods and Optimization Techniques**

Continuation of 3.898 to cover Polya's theory of counting; selected topics in optimization techniques, which include transport networks, matching theory, linear programming, and an introduction to dynamic programming. *Prep. 3.898, Combinatorial Mathematics.*

Winter quarter

**3.8A1 Mathematical Methods in Computer Science**

Algebraic concepts relevant to computer science; sets, relations, mapping, orderings, algebraic systems, Boolean algebras, groups, rings, finite fields, introduction to vector spaces and linear algebras over finite fields. *Prep. Bachelor of Science degree in Engineering or Science.*

Fall & spring quarters

**3.8C1 Mathematical Methods in Electrical Engineering I**

Complex variable theory; mapping by functions, definite and indefinite integrals, Cauchy integral formula, Laurent series, the residue theorem and branch points. Not open to Northeastern graduates who have completed 3.292. *Prep. Bachelor of Science degree in Engineering or Science.*

Fall quarter

**3.8C2 Mathematical Methods in Electrical Engineering II**

A continuation of 3.8C1 that includes application of complex variable theory to Fourier theory, Hilbert transforms, and conformal transformations in the analysis of linear systems and in electrostatics; the Schwarz-Christoffel transformation, Poisson's integral formula and concept of analytic continuation. *Prep. 3.8C1, Mathematical Methods in Electrical Engineering I.* Winter quarter

**3.8C4 Mathematical Methods in Electrical Engineering III**

Linear algebraic equations; Gauss algorithm; Linear operators in an n-dimensional vector space over infinite and finite fields; characteristic value problem; minimum polynomial; functions of a matrix; Cayley-Hamilton theorem; Sylvester's identity; matrix transformations: equivalence, congruence, similarity; quadratic forms; definiteness; canonical forms under equivalence and congruence transformation; polynomial matrices. *Prep. Bachelor of Science degree in Electrical Engineering.* Fall quarter

**3.8C5 Mathematical Methods in Electrical Engineering IV**

Smith normal form; determinantal divisors; invariant factors; elementary divisors; canonical forms under similarity: companion forms and Jordan form; method of Jordan chains; Segre, Ferrer, and Weyr characteristics; decomposition of a vector space into invariant subspaces. *Prep. 3.8C4, Mathematical Methods in Electrical Engineering III* Winter quarter

**3.8T0 Numerical Methods and Computer Applications (4 q.h. credits)**

This course offered days covers the material in 3.8T1 and 3.8T2, Numerical Methods and Computer Applications, I and II. *Prep. Bachelor of Science degree in Engineering, Mathematics or Physics, a working knowledge of FORTRAN.* Fall quarter

**3.8T1 Numerical Methods and Computer Applications I**

Survey of numerical methods applied to engineering and scientific problems with emphasis on machine implementation and problem solving; roundoff errors and cumulative errors; difference and summation calculus; roots of polynomials and non-linear functions; orthogonal functions including polynomials, least squares, and Chebyshev approximation of functions; systems of algebraic equations, matrix notation, and machine implementation; inversion of matrices including iterative methods; sparse matrix techniques. *Prep. Bachelor of Science in Engineering, Mathematics, or Physics; a working knowledge of FORTRAN.* Fall quarter

**3.8T2 Numerical Methods and Computer Applications II**

Interpolation; numeric quadrature; numeric integration of ordinary differential equations including predictor-corrector methods; stiff dynamic equations, partial differential equations, approximations, boundary value problems. *Prep. 3.8T1, Numerical Methods and Computer Applications I.* Winter Quarter

**3.8T3 Numerical Methods and Computer Applications III**

Linear and dynamic programming, steepest descent and simplex methods, with application to nonlinear functions in n-dimensional space; eigenvalues and eigenvectors of matrices; approximate location of eigenvalues; stability; Routh-Hurwitz criterion; more specialized techniques including the fast Fourier transform, digital simulation of analog computation, system modelling, etc. *Prep. 3.8T2, Numerical Methods and Computer Applications II.* Spring quarter

**3.8T7 Digital Filtering I**

Representation of discrete signals and systems; z-transforms and discrete Fourier transforms; difference equations and state space representation of discrete systems; design of digital filters; recursive and nonrecursive. *Prep. 3.824, Linear Systems Analysis I or equivalent.* Fall quarter

**3.8T8 Digital Filtering II**

Algorithms for fast Fourier transforms, e.g., Cooley-Tukey, Sande-Tukey, etc.; radix two, four and arbitrary algorithms; digital spectra, smoothing techniques, spectral window; effects of quantization truncation and parameter inaccuracies; system performance in the presence of noise; applications to signal processing problems and the solution of partial differential equations. *Prep. 3.8T7, Digital Filtering I or consent of the instructor.* Winter quarter

**3.8T9 Digital Filtering (4. q.h. credits)**

This course, offered days, embodies the material in 3.8T7 and 3.8T8, Digital Filtering I and II. *Prep. 3.824, Linear Systems Analysis I or equivalent.* Spring quarter

**3.9A1 Error Correcting Coding I**

Error correcting codes and their decoding techniques which show promise for applications in digital communication, control and computer systems. Emphasis placed on the linear block codes based on algebraic structures; cyclic codes for random error correction (B-C-H codes) and burst error correction. Some knowledge of elementary aspects of modern algebra is desirable but not necessary. Not to be taken by students who have completed 3.904. *Prep. Bachelor of Science degree in Engineering or Science.* Winter quarter

**3.9A2 Error Correcting Coding II**

Convolutional codes and decoding including the Viterbi algorithm, arithmetic codes. Combination of codes. Coding for ranging and synchronization. Not To Be Taken By Students Who Have Completed 3.908. *Prep. 3.9A1, Error Correcting Coding I or 3.905, Information Theory and Coding.* Spring quarter

**3.9C1 Data Transmission I**

Deals with the theoretical and practical aspects of digital data transmission in the presence of channel distortion and additive noise. Topics covered in this quarter include the basic binary and M-ary modulation techniques namely, PSK, PAM, FSK, orthogonal and bi-orthogonal signaling, and their performance in an additive Gaussian noise channel; signal design techniques for band limited channels; Nyquist criteria; effect of channel amplitude and delay distortion on performance; and adaptive equalization. *Prep. 3.901, Applied Probability and Stochastic Processes II or 3.902, Applied Probability and Stochastic Processes.* Fall quarter

**3.9C2 Data Transmission II**

Discussion of several adaptive equalization algorithms for combatting intersymbol interference; maximum likelihood sequence estimation and the Viterbi algorithm; the characterization of fading multipath channels; diversity reception techniques; characterization of atmospheric and man-made (impulsive) noise in radio communications, its effect on error-rate performance; and receiver processing techniques for combatting impulsive noise. *Prep. 3.901, Applied Probability and Stochastic Processes II or 3.902, Applied Probability and Stochastic Processes.* Winter quarter



*The two-part sequence which follows serves to introduce students in engineering and physics to the notions of probability, random variables and stochastic processes. The subject matter is given below.*

### **3.900 Applied Probability and Stochastic Processes I**

Introductory probability, sample space and random variables, examples of discrete and continuous probability distribution functions, averages, moments and characteristic function, multivariate distributions, change of variables and functions of variables, central limit theorem, description of stochastic vectors. *Prep. Bachelor of Science degree in Engineering or Science.* Fall, winter, and spring quarters

### **3.901 Applied Probability and Stochastic Processes II**

General concepts of stochastic processes, stationarity and ergodicity, stochastic continuity and differentiation, the Gaussian process, linear systems with stochastic inputs, correlation functions and power spectra, matched filtering, stochastic orthogonality and linear mean-square estimation filtering and prediction. *Prep. 3.900, Applied Probability and Stochastic Processes I.*

Fall, winter, and spring quarters

### **3.902 Applied Probability and Stochastic Processes (4 q.h. credits)**

Includes the material given in 3.900, Applied Probability and Stochastic Processes I and 3.901, Applied Probability and Stochastic Processes II. *Prep. Bachelor of Science degree in Engineering or Science.* Fall, winter, and spring quarters

### **3.903 Information Theory**

Deals principally with three aspects of information theory; the statistical description of sources and the probabilistic measure of their information contents, the determination of channel capacity, and the fundamental coding theorems. *Prep. 3.900, Applied Probability and Stochastic Processes I or 3.902, Applied Probability and Stochastic Processes or Probability.* Fall quarter

### **3.905 Information Theory and Coding (4 q.h. credits)**

Includes the material given in 3.903, Information Theory and 3.904, Error Correcting Coding. *Prep. 3.900, Applied Probability and Stochastic Processes I or 3.902, Applied Probability and Stochastic Processes.* Spring quarter

### **3.906 Detection and Estimation Theory A**

This course presents the classical theory of signal detection and estimation. Particular topics include: likelihood ratio tests for detection of known or random signals; calculation of error probabilities; the signal selection problem; and maximum likelihood estimation of signal parameters. *Prep. 3.901, Applied Probability and Stochastic Processes II or 3.902, Applied Probability and Stochastic Processes.*

Winter quarter

### **3.907 Detection and Estimation Theory B**

This course is a continuation of 3.906 stressing application of the theory. Particular topics include: synthesis of an adaptive receiver; ambiguity function; estimation of angle modulated signals; and selection of features and training algorithms in pattern recognition. *Prep. 3.906, Detection and Estimation Theory A.* Spring quarter

### **3.908 Special Topics in Communication Theory**

Current aspects of communication theory not covered in previous courses. Subject matter may change from year to year. Subjects in 1976-77 and 1977-78 are:

Fall quarter - speech analyses, synthesis and transmission through lecture, directed readings and discussion. Special topics include speech perception, speaker identification and verification, automatic word recognition, computer generated speech, voice response systems and speech transmission and compression operating at data rates between 600 and 6400 bits/second. *Prep. 3.824, Linear System Analysis or equivalent; 3.8T7, Digital Filtering I or equivalent.*

Winter Quarter — Not Offered

Spring Quarter — Applications in Optics

Characterization and processing of optical signals, topics include a Linear System Theory of imaging; the lens as a Fourier Transformer; modulation transfer function; phase distortions; film and diode detector noise, coherent (holographic) and incoherent filtering; synthetic apertures; sampled images (a lisma, sampling jitter, noise), digital picture processing (detection, filtering, enhancement); and bandwidth comparison for transmission or storage. *Prep. 3.901, Applied Probability and Stochastic Processes II*

### **3.909 Detection and Estimation Theory (4 q.h. credits)**

Offered days. Includes the material given in 3.906 and 3.907, Detection and Estimation Theory A and B. *Prep. 3.901, Applied Probability and Stochastic Processes II or 3.902, Applied Probability and Stochastic Processes.* Winter quarter

### **3.910 Nonlinear Systems I**

Operators and functionals. Functional power series representation of nonlinear systems. Functional representation of the response of a nonlinear system when its input is either a constant, a sinusoid, a transient. System transforms. Applications to the analysis and synthesis of nonlinear systems in terms of functional power series. *Prep. An undergraduate course in Signals and Systems and 3.900, Applied Probability and Stochastic Processes I or equivalent.* Fall quarter

### **3.911 Nonlinear Systems II**

Nonlinear systems with random inputs. Functional representation of the response of a nonlinear system when its input is a random process. Orthogonal systems of functionals. Representation and analysis of nonlinear systems in terms of orthogonal systems of functionals. The optimum nonlinear filter, predictor, and general operator. Special classes of nonlinear systems. Determination of optimum nonlinear systems for generalized error criteria. *Prep. 3.910, Nonlinear Systems I and either 3.901, Applied Probability and Stochastic Processes II or 3.902, Applied Probability and Stochastic Processes.* Winter quarter

### **3.912 Nonlinear Systems III**

Functional analysis of systems characterized by nonlinear differential equations. Operator approach to system theory and its relationship to differential equation representations. The methods of iteration in nonlinear theory and its application to feedback systems. *Prep. 3.911, Nonlinear Systems II.* Spring quarter

### **3.913 Optical Storage and Display**

Survey of materials and methods for the storage and display of information. Topics included are: photographic film, holograms, storage tubes, magneto-optical films, photochromic materials, electro-optical crystals, evaporated thin films and liquid crystals. *Prep. 3.914, Electro-Optics I or equivalent.* Fall quarter

**3.914 Electro-Optics I — Introduction**

Introduction to the principles of electro-optical systems; imaging and nonimaging devices. Topics included are: optical imaging, sources, detectors, transmission, absorption scattering, polarization, system evaluation and limitation. *Prep. 10.8A4, Advanced Mathematics or 3.823, Mathematical Methods in Electrical Engineering or equivalent.* Spring quarter

**3.915 Electro-Optics II — Imaging Devices**

Detailed theory of image formation; evaluation of optical instruments; detailed description of representative systems; test procedures and critical alignment techniques. *Prep. 3.914, Electro-Optics I or equivalent.* Fall quarter

**3.916 Fourier Optics I**

This two-quarter sequence covers: optical diffraction and imaging problems as linear systems; necessary tools of Fourier Analysis and linear systems analysis which occur when solving the scalar wave equation; waves and their properties; reflection, refraction, polarization, and propagation of waves; foundations of scalar diffraction theory — including Fresnel and Fraunhofer diffraction, interferometry, division of amplitude, division of wavefront, interferometric instrumentation, Fourier transforming, image properties of lenses, coherent and incoherent imaging; and advanced topics in the application of communication theory to optical problems, transfer and spread functions, spatial filtering, and holography. *Prep. 3.915, Electro-Optics II or equivalent.* Winter quarter

**3.917 Fourier Optics II**

Continuation of 3.916. *Prep. 3.916, Fourier Optics I.* Spring quarter

**3.918 Experimental Optics I**

Should be taken concurrently with 3.915, Electro-Optics II.  
1 hour lecture, 2 hours laboratory. Fall quarter

**3.919 Experimental Optics II**

Should be taken concurrently with 3.916, Fourier Optics I.  
1 hour lecture, 2 hours laboratory. Winter quarter

**3.920 Experimental Optics III**

Should be taken concurrently with 3.917, Fourier Optics II.  
1 hour lecture, 2 hours laboratory. Spring quarter

The laboratory course provides practical experience in experimental optics to supplement the theory developed in the electro- and Fourier optics lectures. Topics include: geometrical properties of lenses, aberrations, and resolution measurements; diffraction effects in optics and in lens systems; interferometric techniques applied to precise optical measurements and to image evaluation. Optical transfer function, spatial optical filtering and Fourier transformation concepts are studied in the laboratory; investigation of holographic techniques and the coherence of light.

**3.921 Optical Properties of Matter I — Crystals**

Optics of crystals; classification and effects of crystal symmetry on optical properties; classical description of wave propagation in crystals; applications of the theory to modulation, pulse generation, non-linear optics. *Prep. 3.914, Electro-Optics I.* Fall quarter

**3.922 Optical Properties of Matter II**

Introduction to electro-optical and magneto-optical effects in material media; linear and non-linear optical materials; elasto-optic and acousto-optical materials; polarization and propagation effects; modulation. *Prep. 3.921, Optical Properties of Matter I — Crystals.* Winter quarter

**3.923 Optical Properties of Matter III**

Thin films and optical fibers; multilayer filters; dichroics; integrated optics. *Prep. 3.922, Optical Properties of Matter II.* Spring quarter

**3.924 Advanced Topics in Electro-Optics**

Special topics in modern optics and optical techniques requiring the presentation of a paper by participants at termination of the course. *Prep. Consent of the Director of the Electro-Optics Program.* Offered by special arrangement

Additional courses on the optics sequence are 3.980, 3.981, 3.982, 3.983, and 3.984.

**3.925 Power Circuit Analysis I**

Fundamental concepts of single-phase and polyphase power systems; definitions of terms; use of per unit quantities; equivalent circuits of symmetrical 3-phase systems; introduction to symmetrical components; short circuits on systems with a single power source. *Prep. Bachelor of Science degree in Electrical Engineering.* Fall quarter

**3.926 Power Circuit Analysis II**

This course is a continuation of 3.925, Power Circuit Analysis I. Sequence impedances of various power-system elements are considered from application point of view; unsymmetrical faults on otherwise symmetrical 3-phase systems; open conductors and asymmetrical connections and loadings; analysis of simultaneous faults on 3-phase systems; 2-phase systems. *Prep. 3.925, Power Circuit Analysis I.* Winter quarter

**3.927 Power Circuit Analysis III**

This course is a continuation of 3.926, Power Circuit Analysis II. Introduction to Clarke components and applications in analysis of asymmetrical systems and faults; transmission line theory; protective relaying; fundamentals of system stability. *Prep. 3.926, Power Circuit Analysis II.* Spring quarter

**3.928 Analysis of Power Systems (4 q.h. credits)**

Offered days. This course is designed to provide the basic material, including special mathematical techniques, applicable to the solution of problems associated with power systems. The sequence-impedance characteristics of various power-system elements are investigated with emphasis on application rather than design. Abnormal situations including simultaneous faults and system transients are treated in depth, making use of Clarke components and modified Clarke components as well as symmetrical components. Polyphase transmission line theory, system protection and system stability are introduced and discussed briefly. *Prep. Bachelor of Science degree in Electrical Engineering.* Fall quarter

**3.929 Solid State AC and DC Motor Control Systems**

The application of solid-state devices to the control of AC and DC electrical machinery, including rectifiers, inverters, choppers and cyclo-converters, as applied

to drive systems in industry and transportation. The course will emphasize a case-method approach. *Prep. A background in electric machinery.* Spring quarter

### **3.930 Power System Planning**

Engineering and economic aspects underlying system development and planning. Probability methods of determining installed and spinning-reserve requirements. Mathematical models of system operation for production-costing studies. Detailed examples include economic comparison of nuclear and fossil-fired plants, the role of pumped-hydro generation, power pooling, and coordinated planning of interconnected systems, and the functions of high-voltage and EHV transmission in planning and operation. *Prep. 3.925, Power Circuit Analysis I.* Spring quarter

### **3.931 Power System Planning (4 q.h. credits)**

Offered days. Includes the material given in 3.930 but with more extensive and in-depth coverage. *Prep. 3.928, Analysis of Power Systems or equivalent.* Spring quarter

### **3.932 Power Systems Protection**

Consideration of protection applied to generation, transmission, and distribution. Investigation of the characteristics and operating principles of various methods of protective relaying; analysis of current techniques pertaining to system protection. *Prep. 3.927, Power Circuit Analysis III or equivalent.* Fall quarter

### **3.933 Power System Transients**

Transients in power systems due to system switching, lightning, or faults. Traveling-wave phenomena; insulation coordination; overvoltages due to disturbances on the system; surge protection. *Prep. 3.927, Power Circuit Analysis III or equivalent.* Winter quarter

### **3.935 Computers in Power Systems I**

Techniques used in solving power system problems with the digital computer. Matrix formulations are examined, followed by a detailed treatment of the short-circuit problem, including balanced and unbalanced faults. Various iterative techniques are studied for the solution of the power-flow problem. *Prep. Bachelor of Science degree in Electrical Engineering or equivalent.* Fall quarter

### **3.936 Computers in Power Systems II**

Practical considerations of solving large scale networks are discussed. Network reductions, distribution factors and contingency analysis techniques are developed. Digital models for regulated generators, fixed and load tap changing transformers and HVDC transmission lines are examined. Computer methods for economic dispatch, loss coefficients and application of pumped hydro are developed. *Prep. 3.935, Computers in Power Systems I.* Winter quarter

### **3.937 Computers in Power Systems III**

Computer methods for solving differential equations for application to transient stability problems are examined in detail. Approximate stability models are developed. Introduction to online state estimation, examination of linear estimation models, development of general estimation equations, iterative and direct power system state estimation procedures are discussed. The application of linear programming techniques to power system problems is examined. *Prep. 3.936, Computers in Power Systems II.* Spring quarter

**3.938 Computer Control and Analysis of Power Systems** (4 q.h. credits)

This course, offered days, combines the evening courses 3.935, 3.936, 3.937. *Prep. Bachelor of Science degree in Electrical Engineering or equivalent.* Spring quarter

**3.940 Electric Machinery Theory I**

Review of Maxwell's Field equations, polyphase electric circuits, magnetic circuits. Transformer equivalent circuit and steady-state operation. Electro-mechanical energy-conversion principles, volt-ampere equations and torque equation for rotating machines. Constructional and winding aspects of rotating machines. Steady-state analysis of synchronous and induction machines. *Prep. Bachelor of Science degree in Electrical Engineering or 3.975, 3.976, and 3.977, Precs of Modern Electrical Engineering I, II, and III.* Fall quarter

**3.941 Electric Machinery Theory II**

Development of the coupled-circuit equations of the synchronous machine; Park's transformation; per unit systems; the synchronous machine phasor diagram and steady-state analysis. *Prep. 3.940, Electric Machinery Theory I or equivalent.* Winter quarter

**3.942 Electric Machinery Theory III**

Synchronous machine dynamics; analysis of balanced and unbalanced faults; starting and out-of-step operation; protection and control of synchronous machines; analysis of the a-c induction machine. *Prep. 3.941, Electric Machinery Theory II.* Spring quarter

**3.943 Advanced Power Laboratory**

Offered days. In-depth investigations of the steady-state and dynamic modes of operation of rotating machines. Polyphase rectification and control circuits. Experimentation in other related power areas. *Prep. Bachelor of Science degree in Electrical Engineering.* All quarters

**3.944 Special Topics in Power**

Offered days. (Part-time students may enroll in this course only by special arrangement.) Directed reading and discussion of topics of special interest in the power field. Series of lectures by guest speakers from industry on topics of particular interest to the power student. *Prep. Permission of instructor.* All quarters

**3.945 Power System Transient Stability**

Analysis and solutions of the transient stability problem; the swing equation and its solution by numerical methods; the equal area criterion; synchronous machine models; consideration of excitation system response, early volving, and independent-pole circuit breakers as they affect stability. *Prep. 3.927, Power Circuit Analysis III or equivalent.* Fall quarter

**3.950 Systems Analysis I-A**

Review of probability and statistics. Elements of Markov processes, queuing as a Markov process. Finite and infinite queue systems, multiple-server, parallel and sequential queuing; fundamentals of reliability theory. *Prep. Bachelor of Science degree in Engineering or Science.* Fall quarter

**3.951 Systems Analysis I-B**

Flow-graph representation of queuing systems, equivalence of flow-graph and analog-computer representation; fundamental concepts in game theory; solution of rectangular games; pure and mixed strategies, maximin and minimax principle; zero and non-zero-sum games, infinite games; transformation of games into linear programming problems. Other methods of solving competitive-situation problems. *Prep. 3.950, Systems Analysis I-A.* Winter quarter

**3.952 Systems Analysis II**

Modelling of systems problems in terms of linear programming approach. Transportation problem; graphical representation and solution of linear-programming problems; allocation problem; simplex method; concept of duality and its use in linear programming. *Prep. 10.8A4, Advanced Mathematics or 10.9N2, Advanced Mathematics.* Spring quarter

**3.953 Systems Analysis III**

Optimization of stochastic systems. Markov-process approach to the analysis of probabilistic systems. Z-transform analysis of Markov processes. Solution of sequential decision processes by value and policy iteration. Single-chain and multi-chain systems. Sequential decision processes with discounting. Machinery and car replacement problem, and other applications. *Prep. 3.950, Systems Analysis I-A, 3.952, Systems Analysis II, 10.8G1, Probability or equivalent.* Fall quarter

**3.954 Systems Analysis (4 q.h. credits)**

Offered days. Includes the material given in 3.950 and 3.951 — Systems Analysis I-A and I-B. *Prep. Bachelor of Science degree in Engineering or Science.* Spring quarter

**3.955 Studies in Electric Power Transmission I**

Elements in the design of AC overhead transmission lines; thermal limitations, series and shunt compensation, environmental effects; consideration of transposition, induced effects, and insulation level. Underground alternatives to overhead lines. Elements of distribution. *Prep. 3.927, Power Circuit Analysis III or equivalent.* Winter quarter

**3.956 Studies in Electric Power Transmission II**

Fundamental concepts of high voltage DC power transmission; rectifier and inverter performance; regulation; protection; reactive power and filter requirements; practical arrangement of DC lines; the impact of a DC line on overall power system operation. *Prep. 3.927, Power Circuit Analyses III or equivalent.* Spring quarter

**3.957 Control System Analysis**

Classical analysis techniques for continuous and sampled-data control systems. Discussion of stability criteria; application of root-locus and Bode methods for complementary time and frequency-domain analysis. Consideration of nonlinear systems and development of techniques for stability analysis. Computer simulation of typical control systems will be emphasized. *Prep. Bachelor of Science degree in Engineering; knowledge of transform analysis and some familiarity with FORTRAN.* Fall quarter

**3.958 Control System Synthesis**

A review of cascade and feedback compensation techniques with the use of classical criteria for design of continuous and sampled-data control systems. Consideration of the multiple-input problem. A survey of pole-zero synthesis methods, and comparison with other techniques. Computer simulation of design examples. *Prep.* 3.957, *Control System Analysis or equivalent.* Winter quarter

**3.959 Control Systems I (4 q.h. credits)**

Includes the material given in 3.957, Control System Analysis and 3.958, Control System Synthesis. Open to qualified undergraduate students. *Prep.* Knowledge of transform analysis and some familiarity with FORTRAN. Fall quarter

**3.960 Control System Practice**

A further study of control systems with emphasis on the practical aspects of control system design. Discussion of digital compensation and computer-in-the-loop realizations. Consideration of system hardware and software problems. Case studies and a field trip will be included. *Prep.* 3.959, *Control Systems I or equivalent.* Spring quarter

**3.961 Optimal Control Theory**

Introduction to optimal control theory with reference to aerospace and process control applications. Variational calculus development of the maximum principle. Numerical solutions using dynamic-programming and steepest-descent algorithms. The optimal linear regulator problem and the matrix Riccati equation. *Prep.* 3.959, *Control Systems I or equivalent.* Fall quarter

**3.962 Control Systems II (4 q.h. credits)**

Includes the material given in 3.960, Control System Practice and 3.961, Optimal Control Theory. *Prep.* 3.959, *Control Systems I or equivalent.* Winter quarter

**3.963 Stochastic Control Theory**

Statistical models for random signals; representation of dynamic systems excited by stochastic inputs. Optimal filtering, prediction and smoothing for discrete and continuous systems. Observer theory and feedback of estimated states for effective closed-loop control in a noisy environment. *Prep.* 3.900, *Applied Probability and Stochastic Processes I or equivalent.* Winter quarter

**3.964 Estimation, Identification, and Control**

Estimation theory for dynamic systems based on Bayesian and maximum likelihood methods. The system identification problem. Implementation of numerical algorithms for parameter identification and adaptive control. *Prep.* 3.963, *Stochastic Control Theory.* Spring quarter

**3.965 Control Systems III**

Includes the material given in 3.963, Stochastic Control Theory and 3.964, Estimation, Identification, and Control. *Prep.* 3.900, *Applied Probability and Stochastic Processes I or equivalent.* Spring quarter

**3.966 Switching Circuits**

This course, offered in winter quarter, days, covers the material in 3.967 and 3.968 Switching Circuits I and II. *Prep.* 3.8A1 *Mathematical Methods in Computer Science.* Winter quarter



**3.967 Switching Circuits I**

Logical design of combinational switching circuits, including minimization and decomposition of switching functions; multiple output networks; symmetric networks; threshold logic. *Prep. 3.8A1, Mathematical Methods in Computer Science.*

Fall quarter

**3.968 Switching Circuits II**

Logical design of sequential switching circuits, including the finite-state machine model; iterative networks; capabilities and limitations of finite-state machines; state equivalence; synthesis of asynchronous sequential circuits; state assignment problem and partition theory; machine decomposition. *Prep. 3.967, Switching Circuits I.*

Winter quarter

**3.969 Switching Circuits III**

Selected topics from the theory of finite automata, possibly including such topics as machine experiments; information lossless machines; linear sequential machines; finite-state recognizers. *Prep. 3.968, Switching Circuits II.*

Spring quarter

**3.972 Electronic Digital Computers I**

Basic structural aspects and components of a digital computer; coding of digital information; digital arithmetic and algorithms in binary and complement representations; arithmetic operations, theory of sets, Boolean algebra, truth tables, Karnaugh maps, minimization; combinational logic design using basic logic elements, including NAND, NOR, Exclusive — OR, etc; Flip-flops, clocks, and sequential logic; state diagrams; analysis and synthesis in synchronous sequential logic. *Prep. Bachelor of Science degree in Engineering or Science.*

Fall quarter

**3.973 Electronic Digital Computers II**

Synchronous sequential logic (cont'd); magnetic and dynamic storage elements; the concept and model layout of a stored-program digital computer; design of an elementary computer including the arithmetic unit, control unit, memory, input/output unit and bus organization, with incorporation of several types of programming instructions that highlight software-hardware interaction; selected topics in digital systems; speed-up arithmetic algorithms. *Prep. 3.972, Electronic Digital Computers I.*

Winter quarter

**3.974 Electronic Digital Computers III**

The use of hardware description languages such as DDL, CDL, APL; configuration and description of a computer by micro-operations and micro-statements; machine organization of stored-carry addition using Merce's addition algorithm and of a special purpose computer; introduction to micro-programming and micro-program control concepts; examples in microprogramming; functional and operational organization of CPU memory access, memory stack, associative memory, virtual memory, memory addressing and memory loading; selected topics in control, computer and channel organization; computer design simulation techniques in CDL. *Prep. 3.973, Electronic Digital Computers II.*

Spring quarter

**3.975 Precalculus of Modern Electrical Engineering I**

*Prep. Bachelor of Science degree in Engineering or Science plus knowledge of matrix algebra.*

Fall quarter

**3.976    Precs of Modern Electrical Engineering II***Prep. Bachelor of Science degree in Engineering or Science.*

Winter quarter

**3.977    Precs of Modern Electrical Engineering III***Prep. Bachelor of Science degree in Engineering or Science.*

Spring quarter

**3.978    Precs of Modern Electrical Engineering IV***Prep. Bachelor of Science degree in Electrical Engineering or Science.*

Spring quarter

The preceding four precis courses are intended primarily for those whose undergraduate major was in an engineering or scientific field other than electrical engineering. They are also recommended for students 5 to 10 years away from their bachelor's degree in electrical engineering who feel the need for a review of electrical science. They are open only to students in these categories. The material is basically undergraduate in nature but the viewpoint and depth are at the mature level appropriate to graduate students. Part I deals with the theory of electric circuits and linear systems, Part II with electronics, Part III with field theory from the engineering viewpoint, and Part IV with communication theory especially spectral analysis correlation and modulation.

**3.979    Electronic Digital Computers (4 q.h. credits)**

This course, offered days, embodies the material in 3.972 and 3.973 — Electronic Digital Computers I and II. *Prep. Bachelor of Science degree in Engineering or Science.*

Fall and winter quarters

**3.980    Optical Instrumentation Design Concepts**

An introduction to the design of optical instrumentation. Principles and basic concepts rather than a rundown of known optical systems. In sequence the topics are: introduction, mechanical shock and vibration, kinematic designs, application of third order aberrations, simple optical ray tracing, optical testing, tolerances, optical instrumentation, philosophy, functional design, design for quantity production, quality assurance, "special order" design, industrial design, examples and exercises. *Prep. 3.915, Electro-Optics II.*

Spring quarter

**3.981    Principles of Optical Detection I — Application**

Laws governing radiation and radiometry; properties of real radiation sources; detailed description of detection devices (image forming and signal generating); noise; contrast and MTF; detection systems (imaging devices and ranging devices); electro-optical detector systems analysis. *Prep. 3.915, Electro-Optics II or equivalent.*

Winter quarter

**3.982    Principles of Optical Detection II — Theory**

Review of detector parameters; statistics of detector noise; practical considerations in real detectors; detection, resolution and recognition of signals; heterodyne detection and parametric amplification; sub-nanosecond pulse detection calibration of electro-optical detectors; detectors as system components. *Prep. 3.981, Principles of Optical Detection I.*

Spring quarter

**3.983    Fourier Optics III**

The third in a series covering current topics of interest in this field and optical instrumentation. Application of coherence phenomena to optical instrumentation such

as microdensitometers, microscopes, viewers, cameras, spectrophotometric and interferometric instruments; applications of holography, optical data processing and computing, holographic memories, optical modulation, noise and its effects on data collection, synthetic aperture optics and medical application of laser optics. *Prep. 3.917, Fourier Optics II.* Fall quarter

### **3.984 Spectroscopic Instrumentation**

Survey of optical instrumentation employed in analysis and control situations; modern methods of spectrometry and interferometry; optimization of analytical systems; topics in electron spectroscopy, X-ray spectroscopy, microwave spectroscopy, and related fields. *Prep. Bachelor of Science degree in Engineering or Science.* Winter quarter

### **3.985 Fundamentals of Language and Machine Theory I**

First of a three-quarter sequence in theoretical models of languages and computation. Topics include: formal grammars, parsing, lexical analysis techniques; syntax-directed translation schemes; regular and context-free languages; finite automata, pushdown automata; more general languages and their corresponding machine recognizers; an introduction to computability theory; solvability and unsolvability; computational complexity considerations. *Prep. 3.8A1, Mathematical Methods in Computer Science.* Fall quarter

### **3.986 Fundamentals of Language and Machine Theory II**

Continuation of 3.985 *Prep. 3.985, Fundamentals of Language and Machine Theory I.* Winter quarter

### **3.987 Fundamentals of Language and Machine Theory III**

Continuation of 3.986 *Prep. 3.986, Fundamentals of Language and Machine Theory II.* Spring quarter

### **3.988 Special Topics in Computer Science**

Aspects of Computer Science not covered in other courses. The subject matter may change from year to year. Fall, winter, and spring quarters

### **3.989 Computer Peripherals**

Survey of various types of modern computer peripherals, systems considerations, displays (CRT; control units, editing features, graphics, etc.); mass storage (magnetic surfaces; flying heads, recording techniques, disks; file organization, search strategies, mass storage, software, etc.); communications terminals (modems, control procedures, store and forward, multiplexers, etc.); tape units (types, consideration of cost vs. performance, tape labels and formats, magnetic recording on tapes, design features, etc.); future trends in peripherals. *Prep. Bachelor of Science degree in Electrical Engineering or related engineering or sciences.* Spring quarter

### **3.990 Seminar I**

A library survey of a selected topic in the general field of electrical engineering with an oral presentation based on this survey. Participation in the departmental seminar program of guest lectures. *Prep. Bachelor of Science degree in Engineering or Science.* Fall and spring quarters

**3.991 Seminar II**

The preparation of a research paper suitable for publication in a professional journal, plus an oral presentation of this report. *Prep.* 3.990, *Seminar I*.

Winter and spring quarters

**3.993 Doctoral Seminar I**

Two hours per week of presentation and discussion of topics at a level compatible with a doctoral program. Subject matter may cover a wide range of scientific and engineering fields. (Only S or F grades will be assigned for this course.) *Prep.* *Passing of Ph.D. Qualifying Exam*.

Fall quarter

**3.994 Doctoral Seminar II**

Continuation of 3.993, Doctoral Seminar I. (Only S or F grades will be assigned for this course.) *Prep.* 3.993, *Doctoral Seminar I*.

Winter quarter

**3.995 Master's Thesis**

Analytical and/or experimental work conducted under the auspices of the department. *Prep.* *Bachelor of Science degree in Engineering or Science*.

Fall, winter, and spring quarters

**3.996 Doctoral Thesis**

Theoretical and/or experimental work conducted under the auspices of the department. *Prep.* *Passing of Ph.D. Qualifying Exam*.

Fall, winter, and spring quarters

**3.997 Doctoral Reading**

Material approved by the candidate's adviser. (Only S or F grades will be assigned for this course.) *Prep.* *Passing of Ph.D. Qualifying Exam*.

Fall, winter, and spring quarters

**3.998 Special Problems in Electrical Engineering**

Theoretical or experimental work under individual faculty supervision. *Prep.* *Consent of dept. chairman*.

Fall, winter, and spring quarters

**3.999 Electrical Engineer Degree Thesis Research.**

*Prep.* *Admission to Engineer Degree Program*.

Fall, winter, and spring quarters

## CHEMICAL ENGINEERING

**4.801 Advanced Chemical Engineering Calculations (4 q.h. credits)**

The study of complex material and energy balances is undertaken with the view to apply these to actual plant conditions. *Prep.* *Bachelor of Science degree in Chemical Engineering, including Differential Equations*.

**4.802 Special Topics in Chemical Engineering Mathematics (4 q.h. credits)**

Formulation and solution of problems involving advanced calculus as they arise in chemical engineering situations. Methods covered will include ordinary differential equations, series solutions, complex variables, Laplace transforms, partial differential equations, and matrix operations. Emphasis will be placed on methods for formulating the problems. It will be assumed that the student has been exposed to some of these topics in appropriate mathematics courses. *Prep.* 10.147, *Mathematical Analysis or equivalent*.

Offered yearly, fall quarter

**4.803 Numerical Techniques in Chemical Engineering** (4 q.h. credits)

Digital computer applications to chemical engineering problems. Topics covered include location of roots of linear and non-linear equations, numerical integration, and curve-fitting techniques with emphasis on the numerical solution of ordinary and partial differential equations and to the subject of linear algebra. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, winter quarter

**4.806 Optimization Techniques** (4 q.h. credits)

Several mathematical optimization techniques are developed and applied to chemical engineering problems. Emphasis on a thorough understanding of a single, representative technique selected from among many within its class. Topics include single variable search (Fibonacci Search), multi-dimensional search (Pattern Search), linear systems (Linear Programming) and sequential operations (Dynamic Programming). *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, spring quarter

**4.811 Special Topics in Chemical Engineering Thermodynamics** (4 q.h. credits)

Classical thermodynamics as a method of approach to the analysis of processes of interest to chemical engineers. A study of chemical and phase equilibria involving the various states of matter; prediction and correlation of physical, chemical, and transport properties of gases and liquids; elementary concepts of quantum and statistical mechanics to interpret the empirical properties of classical thermodynamics. Fundamental principles are reviewed to the extent needed. *Prep. Undergraduate Chemical Engineering Thermodynamics.* Offered yearly, winter quarter

**4.812 Chemical Equilibria**

This course embodies those elements of 4.811 which are concerned with the thermodynamics of chemical equilibria. Topics covered include auxiliary functions, the conditions of equilibrium, equilibrium of reactions involving gases, and the phase rule as applied to heterogeneous reaction systems. *Prep. Graduate Standing in Chemical Engineering.* Offered 1975-76, spring quarter

**4.821 Corrosion Fundamentals**

Economic factors basic theories, types, behaviors of specific systems, and protection against corrosion are studied. Wherever possible, engineering applications of the principles are emphasized. *Prep. Bachelor of Science degree.*

**4.823 Transport Phenomena** (4 q.h. credits)

A consideration of the relationships of mass, momentum, and energy transfer. Fundamental equations of change covering the transport of momentum, heat, and mass are developed to illustrate the essential unity of the transport processes. Molecular, microscopic, and macroscopic systems are studied. It will be seen that much of the theory behind the engineering calculations on which the unit operations of chemical engineering are based can be organized and integrated in terms of equations of change. *Prep. Advanced Mathematics and Unit Operations or equivalent.* Offered yearly, winter quarter

**4.824 Transport Processes**

A consideration of the relationships of mass, momentum, and energy transport. Fundamental equations of change for these types of transport are derived and solved for

various chemical and physical systems. Certain transport processes within the human body are also considered. *Prep. Advanced Mathematics or undergraduate Transport Phenomena or permission.* Offered 1975-76, winter quarter

#### **4.825 Sampled-Data Process Control**

Signal sampling; z-transformation; pulse transfer functions; open and closed loop systems; stability; frequency and z-domain design methods. *Prep. Undergraduate Process Control or permission.*

#### **4.826 Experiments in Process Control**

Laboratory experiments related to controllers, control valves, transmitters, attainment of process dynamics by various methods, and control loop performance are performed and analyzed. *Prep. Undergraduate Process Control or permission.*

#### **4.827 Chemical Process Control I**

Review of classical control techniques; state variable representation and analysis of continuous systems with applications to process control. *Prep. Undergraduate Process Control or permission.*

#### **4.828 Chemical Process Control II**

Frequency domain process dynamics and control system analysis; feedforward and cascade control applications; associated papers from the chemical engineering literature. *Prep. 4.827, Chemical Process Control I or permission.*

#### **4.829 Special Topics in Chemical Process Control (4 q.h. credits)**

Review of classical control techniques; state variable representation and analysis of continuous systems with applications to process control. Frequency domain process dynamics and control system analysis; feedforward and cascade control applications; associated papers from the chemical engineering literature. *Prep. Undergraduate Process Control or permission.*

#### **4.830 Advanced Topics in Chemical Process Control (4 q.h. credits)**

Topics related to the analysis and synthesis of sampled-data process control systems; associated papers from the chemical engineering literature. *Prep. 4.829, Special Topics in Chemical Process Control or permission.*

#### **4.832 Chemical Data Estimation**

Methods of obtaining physical and thermodynamic properties of chemical compounds and systems without resorting to laboratory investigation. Latest empirical relationships and physical and thermodynamic laws are introduced to obtain data for plant design and other chemical and engineering uses. *Prep. Bachelor of Science degree.*

#### **4.833 Research Techniques I (4 q.h. credits)**

The essential techniques of research including experimentation, mathematical modeling, data reduction, and graphical presentation techniques. For students in the non-research options (M.S. and D.Eng.). *Prep. Bachelor of Science degree and registration in non-thesis M.S. or D.Eng. program.* Offered yearly, all quarters

#### **4.834 Research Techniques II (4 q.h. credits)**

Continuation of 4.833. *Prep. 4.833.*

Offered yearly, all quarters

**4.835 Analytical and Numerical Techniques** (4 q.h. credits)

For students interested in solving comprehensive problems using computer methods. Problems solved in the course will be based on the interest of the students and staff and will be individual. *Prep. Bachelor of Science degree and knowledge of digital computer programming.*

**4.838 Modeling and Simulation of Chemical Processes**

Consideration of current approaches to steady and unsteady state process simulation. Structure of simulators. Computational efficiency. Convergence acceleration. Articles from the Chemical Engineering literature. *Prep. Undergraduate plant Design.*

**4.840 Advanced Management Techniques in the Chemical Industry** (4 q.h. credits)

Management techniques applied to the chemical industry. Special attention to management of research organizations and to management of engineering services, such as design, computer, and related activities. *Prep. Graduate standing.*

Offered yearly, winter quarter

**4.845 Advanced Plant Design Concepts** (4 q.h. credits)

Modern approaches to plant design; computer-oriented design, analysis and simulation of chemical processes, use of strategy decision making in design, advanced scheduling and planning techniques. *Prep. Undergraduate plant design course, knowledge of digital computer programming.*

Offered yearly, spring quarter

**4.850 Chemical Process Pollution Control (Water)** (4 q.h. credits)

Provides chemical engineering students with basic fundamentals for handling environmental problems in the chemical process industries. Water quality requirements and industrial waste characteristics; wastewater treatment processes applicable to environmental engineering; biological treatment processes and equipment; comprehensive design problems involving biological and tertiary treatment; the economics of water treatment and reuse. *Prep. Graduate standing in Chemical Engineering. Open to selected ChE seniors.*

**4.855 Wastewater Treatment Technology**

Industrial waste treatment technology for various specific contaminants found in industrial wastes with emphasis on the chemical process industries. Information on sources and levels of contaminants, existing methods of treatment, levels of treatment attainable, and associated costs. *Prep. Graduate standing in Chemical Engineering.*

**4.860 The Energy Crisis: A Survey**

The energy resources of the United States in comparison to the projected demands upon them over the next two decades. Energy sources alternative to fossil fuels such as: nuclear power, hydropower, geothermal and solar power are discussed with regard to the feasibility of their extensive application by the year 2000. Focus upon technical requirements, and economic and environmental impact. *Prep. Bachelor of Science degree.*

**4.861 The Energy Crisis: Fuel to Fuel Conversion**

Energy problems associated with the oil, gas, and coal industries. The relative merits of various processes for converting one fuel to another, including the gasification of coal to produce either a low-BTU gas or pipeline quality gas. Production of oil from oil shale, coal, and tar sands. *Prep. Bachelor of Science degree.*

**4.862 The Energy Crisis: Solar Energy**

The role of solar energy as a future energy resource in relation to its present state of development. The characteristics of solar radiation and methods of collecting, storing and converting the energy. Emphasis on documented technical and economic experience with solar energy reported in the literature. Current research proposals aimed at harnessing the sun's energy. *Prep. Bachelor of Science degree.*

**4.890 Seminar in Chemical Reactor Analysis (4 q.h. credits)**

Effects of fluid mixing, temperature and reaction rate model on the performance of chemical reactors. Specific topics covered are macro- and micromixing in homogeneous media, boundary conditions for tubular flow reactors, stability of non-isothermal reactors, optimal reactor performance and radical polymerization. *Prep. Thermodynamics, undergraduate Chemical Engineering Kinetics or equivalent.*

Offered yearly, winter quarter

**4.891 Selected Topics in Kinetics of Chemical Processes (4 q.h. credits)**

Theoretical foundations are developed for the investigation and rationalization of chemical reaction rates. Rate theories regarding elementary steps; sequential reactions using the steady-state approximation; correlations of homogeneous and heterogeneous catalysis; matrix methods applied to the analysis of reaction networks. *Prep. Undergraduate Thermodynamics.*

Offered yearly, fall quarter

**4.899 Special Topics in Chemical Engineering (4 q.h. credits)**

Topics of interest to the staff member conducting this class are presented for advanced study. A student may not take more than one Special Topics course with any one instructor. *Prep. Permission of department staff.*

Offered yearly, all quarters

**4.973 Special Topics in Chemical Process Heat Transfer (4 q.h. credits)**

Empirical methods and calculations used to design heat transfer equipment for the chemical process industries. Review of basic heat transfer principles. Shell-and-tube calculations for liquid and/or vapor phase heat transfer. Direct contact and other special heat exchanger applications. *Prep. Undergraduate Heat Transfer.*

**4.974 Selected Topics in Fluid Mechanics (4 q.h. credits)**

Discussion of statics, kinematics, and stress concepts associated with fluids. Formulation of the general equations of motion with application to laminar and turbulent flow. Topics on boundary layer theory and compressible flow are included. *Prep. Undergraduate Fluid Mechanics.*

Offered yearly, winter quarter

**4.978 Separation Processes (4 q.h. credits)**

Calculation and design methods used in processes involving mass transfer. Topics covered include vapor liquid equilibria for binary and multicomponent systems, multicomponent distillation, absorption and extraction. Emphasis is placed on methods and techniques which are common to many separation processes. *Prep. B.S. degree in Chemical Engineering.*

**4.990 Seminar**

Topics of an advanced nature are presented by staff, outside speakers, and students in the graduate program. This course must be attended by all master's degree candidates. *Prep. Admission to graduate program in Chemical Engineering.*

Offered yearly, all quarters



**4.991 Thesis (Master's Degree)**

Analytical and/or experimental work conducted under the supervision of the department. For master's degree requirement. *Prep. Admission to Master of Science program in Chemical Engineering.* Offered yearly, all quarters

**4.995 Thesis (Ph.D. Degree)**

Theoretical and experimental work conducted under the supervision of the department. *Prep. Admission to doctoral program in Chemical Engineering.* Offered yearly, all quarters

**4.996 Thesis (D. Eng. Degree)**

Theoretical and experimental work conducted under the supervision of the department. *Prep. Admission to doctoral program in Chemical Engineering.* Offered yearly, all quarters

## INDUSTRIAL ENGINEERING AND ENGINEERING MANAGEMENT

**5.801 Analysis of the Industrial Enterprise I**

A background for the practicing engineer, covering the various phases of operation within the industrial enterprise; history and growth; management selection and development; labor-management relations; product development and marketing; public relations and the corporate image. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, all quarters

**5.802 Analysis of the Industrial Enterprise II**

The environment in which the industrial enterprise operates; modern planning and forecasting; meeting the technological advance; financial aspects within and without the company; the effect of the economic climate; community and government influences. *Prep. 5.801, Analysis of the Industrial Enterprise I.* Offered yearly, all quarters

**5.803 Industrial Organizations**

An analysis of the purpose and functioning of organizations as the basic networks for goal satisfaction through coordination of effort, communication, and responsibility. The approach will be based on modern behavioral science concepts. *Prep. Admission to Program.* Offered yearly, days only, fall quarter

**5.805 Industrial Budgeting for Engineers**

Budgeting plans, programs, and reports for industry today; an introduction to the essentials of fixed and variable budgeting for production, inventory, sales, cash, capital, and cost-volume-profit analysis. *Prep. 5.810, Industrial Accounting or equivalent.* Offered yearly, fall quarter

**5.806 Production Forecasting**

Econometric methods of forecasting the demand for industrial products; emphasis on techniques applicable to individual companies and the total demand. The principal tool used is the mathematical model of the causal factors with special attention to determining the reliability of the model. *Prep. 5.963, Engineering Statistics II or equivalent.* Offered yearly, fall quarter

### **5.808 Basic Engineering Economy**

Economic analysis in formulating business policies and selecting alternatives from possible engineering solutions to industrial problems, present worth, annual cost, and rate of return techniques with continuous and discrete interest calculations. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, all quarters

### **5.809 Advanced Engineering Economy**

Principal emphasis on the practical application of the techniques studied in basic engineering economy; problems of implementation through class discussion of cases and a major term project; recent advances in the techniques of engineering economy, especially those relating to the consideration of uncertainties. *Prep. 5.808, Basic Engineering Economy or equivalent.*

Offered yearly, fall and winter quarters

### **5.810 Industrial Accounting for Engineers**

Introduction of basic accounting principles and procedures; use of accounting data as a management tool; a practical coverage of basic cost procedures related to materials, labor, and manufacturing expense cost control; job order, process, and standard cost systems. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, all quarters

### **5.811 Cost Accounting for Engineers**

Cost accounting procedures as established by accountants are studied and evaluated in terms of being considered by the engineer for cost determination of alternative engineering proposals. *Prep. 5.810, Industrial Accounting or equivalent.*

Offered yearly, winter quarter

### **5.812 Managing Professional Personnel**

Analysis of the particular problems of managing creative people in research, development and engineering based on current developments in general management theory and the behavioral sciences; technical innovation as part of the overall organization; class discussion of cases and student term papers. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, fall, winter and spring quarters

### **5.813 Engineering Communication**

Exploration of practice in the effective preparation and presentation both written and oral, of the results of engineering projects and programs as a basis for business decisions: including formal reports, progress summaries, memoranda, and technical papers. The effective use of various media and audio visual aids based on both audience and material. Consideration of the types of audiences frequently encountered and their needs and reactions as factors in selecting approach. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, all quarters

### **5.814 Development of Engineering Managers**

Analysis of the problems faced by the engineer in the transition from individual contributor to engineering manager; the challenge of engineering management; integrating profession and management objectives; developing guides for engineering managers, to examine their own work and performance, and to improve their effectiveness as well as develop managerial skills in their subordinates. *Prep. 5.801, Analysis of the Industrial Enterprise I.*

Offered yearly, all quarters

**5.816 Industrial Psychology for Engineers**

A general coverage of the application of psychology to industry with emphasis on industrial environments and organization, human relations, group dynamics, tests and measurements, personnel practices, training, and motivation. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, all quarters

**5.817 Advanced Work Design**

Basic philosophies of work design; implementation of work design concepts with case studies; study and analysis of models such as work sampling, sequence or flow of work models; repetitive and nonrepetitive work models, and work measurement models such as standard data; human factors in measuring operator performance; regression analysis approaches; emphasis on development of professional, analytical, and managerial skills and abilities at a systems level. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, spring quarter

**5.819 Human Factors in Man-Machine Systems**

Design of equipment and systems for human use; emphasis on the application of engineering psychology; visual and auditory presentation of information — speech communications, man-machine dynamics, design of controls, layout of work places, and environmental effects on human performance. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, all quarters

**5.820 Personnel Administration for Engineers**

Personnel programs for attracting and retaining technical talent; evaluating effectiveness of major personnel policies; modern methods of salary and wage administration; planning profitable relationships among company, supervisors, and employees. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, winter and spring quarters

**5.822 Product Design and Value Analysis**

Study of design parameters and their effect on development, manufacturing and procurement; functional analysis of components and systems; complete projects and case studies are integrated in the course. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, winter and spring quarters

**5.823 Advanced Production Analysis (4 q.h. credits)**

Study of advanced problem-solving techniques in the areas of method and measurement, layout and facilities planning, material handling and manufacturing process. Case studies and a course project in a local concern illustrate the concepts presented. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, days only, fall quarter

**5.824 Case Studies in Industrial Engineering**

Formulation of problems and analysis of situations on topics such as: work measurement, line balancing, plant layout, regression analysis, wage and salary administration, management information systems and network analysis. Class discussion and written analysis of a variety of cases is included. *Prep. 5.823, Advanced Production Analysis.*

Offered yearly, days only, spring quarter

**5.825 Topics in Production Engineering**

Production problems to include: line balancing, plant location, plant layout and material handling, design of manufacturing systems, job sequencing. Course utilizes

readings, projects and case studies. (Not open to those who have taken 5.823, Advanced Production Analysis.) *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, winter quarter

### **5.830 Financial Management I**

Study of the issues and processes of short-term financing of industrial firms; financial analysis of cases, supplemented by readings to develop familiarity with sources and uses of working capital as well as the goals and problems involved in its management. (Open to Engineering Management majors only.) *Prep. 5.801, Analysis of the Industrial Enterprise I, and 5.810, Industrial Accounting for Engineers, and 5.808, Basic Engineering Economy or equivalent.* Offered yearly, all quarters

### **5.831 Financial Management II**

Extension of Financial Management I with emphasis on analysis necessary to such long-term financial decisions as issuance of stock or bonds; contracting of leases or loans, and financing of a new enterprise; mergers, capital budgeting, the cost of capital, and the valuation of a business. *Prep. 5.830, Financial Management I.* Offered yearly, all quarters

### **5.841 Engineering Project Management**

The management of projects in technically based organizations. Applies a systems approach and provides an understanding of project management practices and techniques for the planning and control of tasks in a performing organization. Using a project life-cycle frame-work, coverage includes the principles and methodology of work definition, planning and scheduling resources, estimation and budgeting, technical performance — schedules and cost control systems. *Prep. 5.812 or 5.814, or Department permission.* Offered yearly, fall and spring quarters

### **5.853 Man-Computer Interaction**

Design and evaluation of the Man-Computer Interface in on-line information systems: formatting of visual displays and auditory outputs, techniques to facilitate operator inputs, pacing and control of the interactive sequence, operator training, task analysis and performance testing. Student projects in areas of novel application. *Prep. 5.819, Human Factors in Man-Machine Systems.*

### **5.860 Health Care Organization and Management**

History of the development and the delivery of health services; health organization functions and inter-relationships of health-oriented organizations; study of certain legal principles and rulings of importance to medical personnel; introduction to interpersonal ethics of patient care. *Prep. Admission to the Graduate School of Engineering.* Offered yearly, fall quarter

### **5.862 Introduction to Occupational Health and Safety**

Accident prevention, accident cost analysis, Federal and local legislation, record keeping requirements under OSHA Act of 1970; occupational safety and health standards, safety programs and inspections, fire prevention and control methods; human behavior and industrial safety, occupational diseases and personnel protective equipment. *Prep. Bachelor of Science degree in Engineering or Science.* Offered yearly, fall quarter

**5.863 Technical Aspects of Health and Safety**

Safety responsibilities of management and employees; methods of hazard control; accident investigation; recognition of chemical, electrical and mechanical hazards; principles of machine guarding; occupational safety and health standards, safety training; toxicology and first aid and medical services. *Prep. 5.862, Introduction to Occupational Health and Safety or permission of the instructor.*

Offered yearly, winter quarter

**5.864 Topics in Physiology and Biomedical Engineering**

Introduction to specific areas relating to human structure and function, and to the use of engineering techniques for medical diagnosis and therapy. Areas considered include blood and blood components, the cardiovascular system, the kidney and urinary systems and respiratory systems. The course will be taught on a seminar basis. Students will be required to do literature research under the guidance of the instructor. *Prep. Permission of instructor.*

Offered yearly, spring quarter

**5.865 Case Studies in Health Systems**

Readings and discussion of case histories of application of systems analysis to field of health. Outstanding administrators and systems analysts from various health organizations will be invited to speak to class. *Prep. Admission to the Graduate School of Engineering.*

Offered yearly, spring quarter

**5.900 Basic Operations Research (4 q.h. credits)**

An introduction to the theory and use of deterministic and stochastic models to represent industrial operations. Models included are those of linear programming, dynamic programming, inventory control, waiting lines, and Monte Carlo simulation. Embodies the material in 5.901 and 5.902, Basic Operations Research I and II. Open to both day and evening students. *Prep. 5.962, Engineering Statistics II or 10.8G1, Probability.*

Offered yearly, fall quarter

**5.901 Basic Operations Research I**

Introduction to the theory and use of deterministic models to represent industrial operations; includes linear programming, dynamic programming, networks, and game theory. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, all quarters

**5.902 Basic Operations Research II**

Introduction to the theory and use of stochastic models to represent industrial operations; includes queuing, inventory, and Markovian models. *Prep. 5.901, Basic Operations Research I and 5.962, Engineering Statistics III or equivalent.*

Offered yearly, all quarters

**5.903 Inventory Control and Production Planning**

The design and operation of inventory systems from a scientific management point of view, including both required theory and practical aspects. Subjects include inventory control models, statistical forecasting, production scheduling techniques, distribution systems, management control and reports, discussion of actual systems, and a case study. *Prep. 5.963, Engineering Statistics or equivalent.*

Offered yearly, spring quarter

**5.904 Queuing Theory and Its Applications**

A development of the theory of queues with emphasis on practical applications, using the latest techniques of Markovian state-transition diagrams to simplify the mathematic model; study of models based on random arrivals and departures including exponential and Erlang service distributions, single and multiple services, series and parallel systems, finite and infinite queues; applications to staffing, inventory control, reliability, maintenance and scheduling. *Prep. 5.900 or 5.902, Basic Operations Research*

Offered yearly, winter quarter

**5.905 Analysis with Simulation**

Model building for digital simulation, testing and validation of models, simulation compiler languages, logic flow charting, applications drawn from economics, scheduling, inventory problems, marketing, and others; programming and running of several models. *Prep. 5.913, Data Processing for Engineers and 5.963, Statistics or equivalent.*

Offered yearly, winter quarter

**5.906 Principles of Dynamic Systems I**

Introduction to modeling of social systems, emphasizing the study of feedback structures and their behavior; development of concepts that allow one to understand the mechanisms underlying growth, stagnation and cyclical fluctuation; examples and practice at formulating models of industrial, economic, social, and ecological systems; study of some of the effects of delays, multiple feedback loops, and nonlinearities; aim to building an intuitive foundation for simulation studies of complex systems. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, fall quarter

**5.907 Principles of Dynamic Systems II**

Continuation of topics from 5.906 with increased experience in the construction and analysis of generic feedback structures; examination of current and previous System Dynamics applications including Urban Dynamics and World Dynamics; exercises in model conceptualization. *Prep. 5.906, Principles of Dynamic Systems I.*

Offered yearly, winter quarter

**5.909 Systems Engineering and Analysis**

Methods of describing, analyzing, and manipulating complex systems both open and closed loop; meaning of system optimization; classical optimization techniques; emphasis on the description and design of a system rather than system manipulation and on "complete" system rather than submanipulation; examples drawn from transportation, information, manufacturing, etc. *Prep. Admission to the Program.*

Offered yearly, days only, winter quarter

**5.910 Analytical Techniques for Engineers**

Linear algebra, transform techniques including Laplace transforms and z transform; systems of linear differential equations. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, fall quarter

**5.911 Linear Programming**

An in-depth development of the theory in formulating the linear programming model for solving the problems of resources allocation, blending of ingredients, cutting stock, and flow-network commonly found in industry; sensitivity analysis, duality

theorem, fundamentals of integer programming. *Prep. 5.900 or 5.902, Basic Operations Research or equivalent and a course in linear algebra.*

Offered yearly, winter and spring quarters

#### **5.912 Network Planning and Control**

Applications of stochastic networks to project management, scheduling, inventory, reliability, quality-control and other industrial applications; review of PERT and its inadequacies, to the development of stochastic flow-graphs and networks; solving for the mean task times and variances using moment-generating functions; setting up the model for computer simulation using GERT. *Prep. 5.962 Prob. of Statistics III*

Offered yearly fall and spring quarter

#### **5.913 Data Processing for Engineers**

Open only to students who have not had a basic course or extensive experience in a compiler language. A study of digital computers and computer programming techniques as applied to management problems. The course will cover the basic characteristics and operation of computing equipment and peripheral devices. The FORTRAN language is presented in depth and will be utilized by the student for programming and running several projects on a computer. Other compiler languages will be described and compared to FORTRAN. A systems approach to the design, development, and implementation of computer programs for solving management problems will be emphasized. Examples will be studied from several management areas. *Prep. Bachelor of Science degree in Engineering or Science.*

Offered yearly, all quarters

#### **5.914 Advanced Operations Research (4 q.h. credits)**

Further study of quantitative techniques available to assist management in scientific decision-making, including Markov processes, utility theory, Bayesian statistics, and forecasting; case studies of real industrial problems. *Prep. 5.900, Basic Operations Research.*

Offered yearly, days only, spring quarter

#### **5.916 Engineering Analysis Utilizing Data Processing**

Engineering and quantitative management problems utilizing medium to large data processing systems; application areas include simulation and file management; the principles of modern operating systems are discussed in detail. *Prep. 5.913 or equiv.*

Offered yearly, fall quarter

#### **5.918 Advanced Operations Research I**

Material covered in 5.918 and 5.919 identical to course 5.914. *Prep. 5.901 and 5.902.*

Offered yearly, winter quarter

#### **5.919 Advanced Operations Research II**

Material covered in courses 5.918 and 5.919 identical to course 5.914. *Prep. 5.918.*

Offered yearly, spring quarter

#### **5.930 Basic Computer Systems Technology**

Introduction to computer systems and assembly language programming. Topics include: machine language, assemblers, and compilers. Input/output device control. List processing, searching, and sorting; file systems and storage management. Students are required to prepare and test several programs. The emphasis is on basic concepts necessary to understand and evaluate technological development. *Prep. 5.913.*

Offered yearly, fall and winter quarters

**5.931 Computer Systems**

Introduction to hardwares and software packages, on-line real-time computer systems, and time-sharing and resource allocation. Telecommunications. Graphics terminals and data collection devices are also discussed. The course seeks to develop the student's understanding of computer technology so that he can successfully employ it in new and creative ways. *Prep.* 5.930.

Offered yearly, winter and spring quarters

**5.932 Advanced Computer Systems**

Topics in the forefront of the computer software field. Discussion of the design choices in Advanced Computer Systems raises the major design and operating issues concerning digital computers. *Prep.* 5.931.

**5.940 Basic Information System Technology**

Introduction to the concepts which support the field of information systems. Introduction to hardware and software systems and structuring problems in computer terms. Both lectures and cases are used to illustrate basic issues which include hardware components and their relative speeds, methods for balancing systems components, models of machines and concepts underlying application programs, translators, utilities, and operation systems. Data structures and data management are treated from the viewpoint of optimizing systems design for large scale data bases. *Prep.* Bachelor of Science degree in Engineering or Science and 5.913.

Offered yearly, fall and winter

**5.941 Management Information Systems**

The development of a framework which emphasizes support to management decision making. Theoretical and pragmatic considerations are used as a base from which a final framework is developed. This framework is applied to the design, installation, and evaluation of traditional management information systems (formerly 5.818). *Prep.* Bachelor of Science degree for Engineering or Science.

Offered yearly, all quarters

**5.942 Information Systems Design**

Designed to provide greater depth and some practical exposure to the issues and concepts raised in Management Information Systems. Topics will include design models for modular systems with emphasis on on-line, real-time systems and project planning and control.

Offered yearly, spring quarters

**5.943 Management Decision Systems Seminar**

Seminar course exploring the design issues involved in building management decision systems. Includes methods of making explicit the manager's decision processes, as well as the design process for building effective man/machine systems. *Prep.* 5.940, 5.941, 5.942.

**5.953 Statistical Decision Theory**

Use of Bayesian statistical inference to arrive at decisions when stochastic variables are interacting; relationship to game theory; decision making over time in a sequence; important expected values and distributions; relationship of Bayesian decision theory to classical statistical inference. *Prep.* 5.962, *Engineering Statistics III* or 10.8G1, *Probability* or equivalent.

Offered yearly, fall quarter



**5.954 Advanced Quality Control**

Mathematical methods of quality control; development of the process control charts for sampling by variables and by attributes; development of acceptance test procedures; development of life-testing plans; cost aspects of quality-control decisions. *Prep. 5.962, Prob. & Statistics III* Offered yearly, fall quarter

**5.955 Mathematical Theory of Reliability**

An introduction to the mathematical theory of reliability and maintainability applied to electrical and mechanical equipments, reliability allocations; failure and repair predictions at the component and system levels; stress-derating techniques; physics of sudden and wear-out failures; reliability/maintainability life-cycle costing plans; design reviews and managerial controls. *Prep. 5.962, Prob. & Statistics III* Offered yearly, fall quarter

**5.956 Reliability and Maintainability Assessment**

The mathematical development of life-test plans for quality-control and reliability; failure-terminated, time-terminated and sequential test plans for reliability demonstrations; maintenance task-times plans for maintain-ability demonstration; economic aspects of each plan; managerial decisions. *Prep. 5.962, Prob. of Statistics III* Offered yearly, winter quarter

**5.957 Reliability Analysis of Complex Systems**

A Markovian-chain state-transition diagram approach to reliability modeling of non-maintained and maintained systems which permits analytic steady-state and dynamic solutions of both the stationary and non-stationary models; setting up the matrix-equations for solution by computer; controlling the numerical oscillations and accuracy of the results. *Prep. 5.955, Mathematical Theory of Reliability* Offered yearly, summer quarter

**5.960 Probability and Statistics I**

Fundamental concepts of probability. Events, event space, sample space, sampling. Axiomatic development events and the algebra of events. Counting, permutations, combinations. Discrete and continuous random variables. Density functions, mass functions, cumulative probability distributions. Expectation of functions of random variables. Conditional, marginal joint distributions. *Prep. B.S. in Eng. Not to be taken by students who have completed course 5.950.* Offered yearly, fall and winter

**5.961 Probability and Statistics II**

Continuation of 5.960. Common discrete and continuous random variables to include binomial, poisson, hypergeometric, normal, exponential, gamma,  $X^2$ , F, uniform and student's t. Mean, variance, MGF, characteristic function. Derived distributions, change of variable. *Prep. 5.960. Not to be taken by students who have completed course 5.951.* Offered yearly, winter and spring

**5.962 Probability and Statistics III**

Limit theorems to include central limit, Chebyshevs, law of large numbers, Point and interval estimators. Properties of estimators — bias, sufficiency, variance. Estimation by moments, max likelihood, Bayes. Hypothesis and hypothesis testing. One and two sided tests. Type I and Type II error. Power curve. *Prep. 5.961. Not to be taken by students who have completed course 5.951.* Offered yearly, fall and spring

**5.963 Statistics**

Review of Hypothesis testing. Tests on mean, variance, difference in means. Courelation, curve fitting, least squares. Multiple regression analysis. Basic concepts of analysis of variance. One and two way classification. *Prep. 5.962.*

Offered yearly, fall and winter

**5.964 Design of Exp. I**

An introduction to experimental design and analysis: modeling for fixed, random and mixed factor designs such as: single factor, randomized blocks, Latin square and factorial experiments, analysis of variance and covariance, orthogonal contrasts. *Prep. 5.951. Not to be taken by students who have completed course 5.952.*

Offered yearly fall and winter

**5.965 Design of Exp. II**

Further design considerations in experimental design and analysis such as: nesting, split-plot, factorial confounding, fractional factorial, response surfaces. Computer applications to design analysis. *Prep. 5.952. Not to be taken by students who have completed course 5.958.*

Offered yearly, spring

**5.966 Probability and Statistics (4 q.h. credits)**

Same material as 5.960 and 5.961 but offered as a 4 q.h. course

Offered yearly, fall quarter

**5.991 Thesis (Master's Degree) (6 q.h. credits)**

Analytical and/or experimental work conducted under the auspices of the department. *Prep. Consent of adviser.*

Offered yearly, all quarters

**5.992 Seminar in Industrial Engineering**

Discussion and presentations of thesis related topics by students, presentations and discussions by faculty and eminent people in the field on timely industrial engineering topics. Field trips and visitations included where appropriate.

Offered yearly, days only, fall quarter

**5.993 Special Problems in Industrial Engineering**

Individual work under faculty supervision. *Prep. Consent of adviser.*

Offered yearly, all quarters

## mathematics and physics

For mathematics and physics courses consult the bulletin of the Graduate School of Arts and Sciences.

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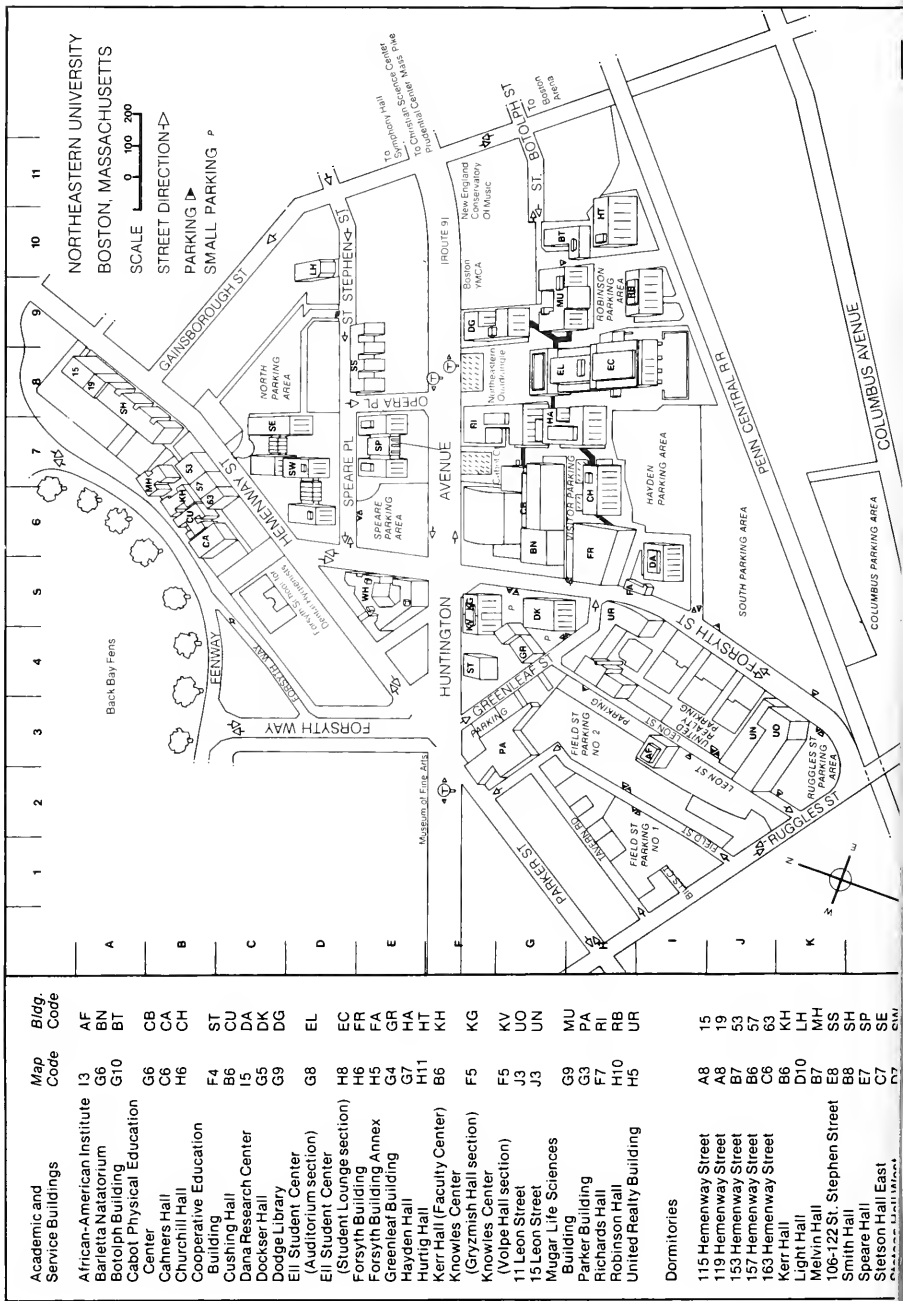


NEW ENGLAND  
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## ACADEMIC CALENDAR 1976—1977

### Fall Quarter 1976

Registration period		
Burlington	Tuesday—Wednesday	Sept. 14—15
Boston	Monday—Thursday	Sept. 20—23
Classes begin	Monday	Sept. 27
Examination period	Monday—Saturday	Dec. 13—18

### Winter Quarter 1976—1977

Registration period		
Burlington	Tuesday	Nov. 30
Boston	Monday—Thursday	Dec. 6—9
Classes begin	Monday	Jan. 3
Examination period	Monday—Saturday	Mar. 21—26

### Spring Quarter 1977

Registration period		
Burlington	Tuesday	Mar. 8
Boston	Monday—Thursday	Mar. 14—17
Classes begin	Monday	Apr. 4
Last day to file card for		
Spring Commencement	Friday	Apr. 1
Last day to pay fee for		
Spring Commencement	Friday	Apr. 29
Final grades due in Registrar's		
Office for June graduates	Friday	June 3
Examination period	Monday—Saturday	June 13—18
Spring Commencement	Sunday	June 19

### Summer Quarter 1977

Registration period		
Burlington	Monday—Tuesday	June 13—14
Boston	Wednesday—Thursday	June 15—16
Classes begin	Monday	June 27
Last day to file card for		
Fall Commencement	Friday	July 1
Last day to pay fee for		
Fall Commencement	Monday	Aug. 1
Examination period	Wednesday—Thursday	Aug. 3—4

## UNIVERSITY HOLIDAYS 1976—1977

Columbus Day	Monday	October 11
Veterans' Day	Thursday	November 11
Thanksgiving Recess	Thursday—Saturday	November 25—27
Christmas Vacation	Monday—Saturday	Dec. 20—Jan. 1
Martin Luther King Day	Saturday	January 15
Washington's Birthday	Monday	February 21
Patriot's Day	Monday	April 18
Memorial Day	Monday	May 30
Independence Day	Monday	July 4
Labor Day	Monday	September 5

## Equal Opportunity Policy

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees.

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Paul D. Maxwell, B.S., M.B.A., *Director of Business Administration Programs and Assistant Dean of University College*

Philip McCabe, B.A., M.Ed., *Dean of Admissions*

Roland H. Moody, A.B., B.L.S. *Director of the University Libraries and Learning Resources*

Timothy L. Moran, B.S., M.Ed., *Director of Law Enforcement Correctional and Security Programs and Associate Dean of University College*

Edmund J. Mullen, B.A., *University Registrar*

Robert Najjar, B.A., M.B.A., *Bursar*

Harold Naidus, A.B., M.S., Ph.D., *Director of Liberal Arts Programs and Associate Dean of University College*

Robert O'Brien, B.S., *Director, Administrative Computer Services*

John C. O'Byrne, A.B., M.S., J.D., *Dean of the School of Law*

Paul M. Pratt, B.S., M.Ed., *Dean of the Department of Cooperative Education*

Gregory T. Ricks, B.A., M.C.P., *Special Assistant to the President*

Nathan Riser, A.B., A.M., Ph.D., *Director of Marine Science Institute*

Norman Rosenblatt, A.B., Ph.D., *Dean of Criminal Justice and Director of the Graduate Program of Criminal Justice*

Philip J. Rusche, B.A., B.S.Ed., M.A., Ed.D., *Director of the Graduate School of Education and Associate Dean of Education*

Albert H. Soloway, B.S., Ph.D., *Dean of Pharmacy and Allied Health Professions and Director of the Graduate School of Pharmacy and Allied Health Professions*

Loring M. Thompson, B.S., M.S., M.A., Ph.D., *Dean of Physical Planning*

Joseph Zabilski, B.S., *Acting Director of Athletics*

## GENERAL UNIVERSITY COMMITTEES

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Daniel J. Roberts, *Vice Chairman*  
Barbara F. Burke, *Secretary*

Harry Allan  
John A. Curry  
Edmund L. Deltano

Eugene M. Reppucci, Jr.  
Roy L. Wooldridge

### The Academic Council

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Kenneth W. Ballou  
Walter S. Jones  
Juanita Long  
Melvin Mark

Frank E. Marsh, Jr.  
John C. O'Byrne  
Norman Rosenblatt  
Albert H. Soloway

John A. Curry, *ex officio*

### The Faculty Senate

Samuel Bernstein  
Charmarie Blaisdell  
John Buoncristiani  
Robert Cord  
\* John Curry  
Robert Curtin  
Ellen Daly  
Flora DeScenza  
John Dromgoole  
Charles Dufton  
\* Ann Duncan-Glasgow  
Ramona Edelin  
Robert Finkenaur  
Edith Flynn  
Norbert Fullington  
Michael Glaubman  
Suzanne Greenberg  
Gerald Herman  
\* Sidney Herman  
Richard Higgins

Donald Jacobs  
Walter S. Jones  
\* John Jordan  
\* Christopher Kennedy  
\* Melvin Mark  
Joseph Meier  
Robert Miller  
Irene Nichols  
\* Paul Pratt  
Andre Priem  
John Proakis  
Gordon Pruett  
\* Daniel Roberts  
John Rosettos  
David Schmitt  
Harold Stubbs  
Paul Tedesco  
Karl Weiss  
Alvin Yorra

### Presiding Officer

Suzanne Greenberg

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\*Appointed by the President

## ORGANIZATION OF THE GRADUATE SCHOOLS

### Administration

Catherine L. Allen, Ed.D., Ph.D., *Director of Boston-Bouvé College Graduate School*

Linda J. Allen, B.A., *Registrar of the Graduate Schools*

Geoffrey Crofts, B. Comm., *Director of the Graduate School of Actuarial Science*

Philip T. Crotty, Jr., M.A., Ed.D., *Acting Dean of Business Administration*

Nancy Dean, M.Ed., *Coordinator of Admissions, Graduate School of Education*

Stephen R. DeRosier, B.A., *Assistant Registrar of the Graduate Schools*

Joseph M. Golemme, M.A., *Director of the Graduate School of Professional Accounting*

George W. Hankinson, M.S., *Director of the Graduate School of Engineering*

John W. Jordan, M.Ed., *Director of the Graduate School of Business Administration*

Thomas J. Kerr, M.S.I.E., *Assistant Director of the Graduate School of Engineering*

Robert H. Ketchum, Ph.D., *Director of the Graduate School of Arts and Sciences*

John J. McKenna, M.A., *Assistant Director, Graduate School of Actuarial Science*

Norman Rosenblatt, Ph.D., *Director of the Graduate Program in Criminal Justice*

Philip J. Rusche, Ed.D., *Director of the Graduate School of Education*

Albert Soloway, Ph.D., *Director of the Graduate School of Pharmacy and Allied Health Professions*

Janice Walker, A.B., *Assistant Director of the Graduate School of Education*

### University Graduate Council

1976—1977

The Council determines broad policies and regulations governing the conduct of graduate work. All new graduate programs must be approved by the Council.

### OFFICERS

Sidney Herman, *Chairman*

Barbara Philbrick, *Vice Chairman*

Joan Lipson, *Secretary*

### **Administrative Members**

Catherine L. Allen  
Philip T. Crotty, Jr.  
George W. Hankinson  
John W. Jordan  
Robert H. Ketchum  
Melvin Mark

Frank E. Marsh  
Norman Rosenblatt  
Philip J. Rusche  
Albert Soloway

### **Elected Faculty Members**

Petros Argyres  
Frederick Blank  
Conrad Caligaris  
Monty Carter  
Andre Favat  
Austin Fisher  
Albert Galmarino  
M. Patricia Golden  
Minton Goldman  
James Gozzo  
Arvin Grabel  
Gerald Griffin  
Thomas Henstock  
Richard Higgins  
Christine Hobart  
James Inashima  
Donald Kosersky  
Louise LaFontaine

Harlan Lane  
Robert Minichiello  
Irene Nichols  
Barbara Philbrick  
John Post  
Robert Read  
Robert Redden  
Nathan Riser  
Alae-Eldin Sayed  
Stephen Schafer  
Joseph Senna  
Albert Soloway  
Ralph Troupe  
Elizabeth Van Slyck  
Robert Wiener  
Joseph Zelinski  
Richard Zobel

### **Administrative Committee of the Graduate Schools**

Sidney Herman, *Chairman*  
Linda Allen, *Secretary*

Catherine L. Allen  
Alvah K. Borman  
Geoffrey Crofts  
Philip T. Crotty, Jr.  
Robert Fuller  
Joseph M. Golemme  
George W. Hankinson  
Walter S. Jones  
John W. Jordan  
Thomas Kerr  
Robert H. Ketchum

Alan A. Mackey  
Melvin Mark  
Frank E. Marsh, Jr.  
Edmund J. Mullen  
John C. O'Byrne  
Barbara Philbrick  
Norman Rosenblatt  
Philip J. Rusche  
Albert Soloway  
Jacqueline A. St. Germain

### *Ex Officio*

James S. Hekimian, *Acting Vice President of Academic Affairs*

### **Committee of the Graduate School of Education**

Philip J. Rusche, *Associate Dean of Education and Director of the Graduate School of Education, Chairman*

Frank E. Marsh, Jr., *Dean of Education*

F. Andre Favat, *Associate Professor of Education*

Thomas F. Henstock, *Assistant Professor of Education*

Louise LaFontaine, *Assistant Professor of Special Education*

Irene A. Nichols, *Associate Professor of Education*

Robert W. Read, *Associate Professor of Education*

Robert B. Redden, *Assistant Professor of Audiology*



# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature by special enactment has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of 178 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922), Liberal Arts (1935), Education (1953), Pharmacy (1962), Nursing (1964); Boston-Bouvé College (1964); the College of Criminal Justice (1967); and by Lincoln College's daytime Bachelor of Engineering Technology program (1971). This educational method enables students to gain valuable practical experience as an integral part of their college program and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses—offered by the University since 1906—and adult-day courses leading to the bachelor's degree. In addition to offering day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The ten graduate and professional schools of the University offer day and evening programs leading to the degrees listed.

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.

The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science.

The Graduate School of Business Administration offers the degree of Master of Business Administration.

The Graduate School of Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degrees of Master of Education and Doctor of Education and the Certificate of Advanced Graduate Study.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer degree, Doctor of Engineering, and Doctor of Philosophy.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

### **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established in 1960 to relate the University to the needs of its community in a period of accelerated change. Adult education programs offered by the Center and University College have since been consolidated. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

### **RESEARCH ACTIVITIES**

The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning take place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

# buildings and facilities

## MAIN CAMPUS

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intrastate lines, and MBTA subway-bus service within the metropolitan-suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 47 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## Ell Student Center

The Carl S. Ell Student Center provides facilities for student recreation and for extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the Center. Also included are special drama facilities, a ballroom, main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

## Libraries

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Burlington; the School of Law Library; and divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, Mathematics and Psychology, and Health, Physical and Recreation Education, and Physical Therapy. There are additional subject collections for the Center for Management Development at Andover, Massachusetts, and the Marine Science Institute in Nahant.

The library collections number 400,000 volumes supplemented by some 333,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,700 periodical titles, 100,000 documents, and 4,600 sound recordings.

### **Cabot Physical Education Center**

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. The large gymnasium contains four basketball courts. In addition, the Center consists of an athletic cage, a small gymnasium, and a rifle range, as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouv  College.

A recent addition to the center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball courts, and shower and dressing facilities.

### **Dockser Hall**

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

### **Apartments for Graduate Students**

The University maintains a 100-apartment housing unit which accommodates 279 people. Two-, three-, and four-party apartments are available which vary in size from two to four rooms plus bath. Apartments are furnished with beds, chairs, desks, stove, refrigerator, and kitchen table. The cost includes all utilities.

A \$100 deposit is required when making application for the apartments. Applications are available in the Office of University Housing. Students are expected to make such arrangements on a term-to-term basis but may live in the apartments both while on cooperative work assignments and in school if they wish. All reservations are made on a first come, first served basis.

## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, physics, mathematics, business administration, science, education, and the arts, portions of undergraduate programs leading to the associate and bachelor's degrees, special programs for adults, and noncredit state-of-the-art programs are offered.

### **Warren Center**

The Warren Center is a practical laboratory for Boston-Bouvé College in outdoor education and conservation, in group practicum, and in camping administration, programming, and counseling. At this Center in Ashland, completed in 1967, there are tennis courts, field hockey and lacrosse fields, waterfront for swimming and boating, overnight camp sites, fields and forests, heated cottages, the Hayden Lodge with a recreation hall, library, crafts shop, dining facilities, and conference accommodations.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.

### **Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility primarily engaged in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at this institute are applicable toward an advanced degree in biology or health science.

### **Brockton, Nashua, and Framingham Campuses**

For students residing in southeastern Massachusetts and northeastern Rhode Island, the Graduate School of Business Administration offers a major portion of its M.B.A. Program at facilities in Brockton, Massachusetts. These facilities, made available by the Veterans Administration Hospital, are conveniently located just off Route 24.

Students residing in the southern New Hampshire area may take a major portion of the M.B.A. Program at facilities in Nashua, New Hampshire. These facilities are furnished by Sanders Associates, Inc. and are located in their headquarters on Route 3, just over the Massachusetts line.

For students in the Framingham-Worcester area, a major portion of the M.B.A. Program may be taken at classroom facilities located in Framingham, Massachusetts.



# the graduate school of education

The Graduate School of Education provides programs leading to the Master of Education degree for in-service educators who wish to pursue a specialization and for individuals who wish to pursue the special areas of study indicated below. A nondegree program for those who wish certification as elementary or secondary teachers is also offered.

Individuals who possess or are eligible for teaching certificates may earn the Master of Education degree in the areas of curriculum and instruction, early childhood education, elementary and secondary administration, emotional disturbance, generic special educator, instructional technology, occupational education, mental retardation, severely handicapped, and early childhood handicapped.

Those individuals who do not possess a teaching certificate may specialize in the areas of career education college counseling, community counseling, cooperative education, rehabilitation counseling, school counseling, educational research, human development, rehabilitation administration, speech pathology or audiology, and special education community personnel.

Programs of study leading to the Certificate of Advanced Graduate Study in the areas of counseling, educational administration, rehabilitation, and special education are offered to those individuals who presently hold a master's degree.

The Graduate School of Education also offers a Doctor of Education (Ed.D.) program in Leadership: Administration and Supervision. Being offered jointly by the Departments of Counselor Education, Educational Administration, and Special Education and Rehabilitation Administration, students may concentrate in the areas of: school administration, rehabilitation administration, pupil personnel administration, student personnel administration, administration of higher education, administration of cooperative education, and special education administration. Students must hold a master's degree in order to apply to this program.

## GENERAL REGULATIONS

The general regulations and minimum requirements for all graduate programs are established by the Northeastern University Graduate Council. In some matters the committee of each graduate school is allowed discretion to establish regulations within limits defined by the council. The regulations and academic requirements which follow have been formulated in accordance with this general policy.

## **Registration**

Students must register within the period listed on the school calendar. Time and place of registration will be announced prior to each period.

## **Residence**

All work for advanced degrees must be completed at the University unless approval has been obtained from the Director of the Graduate School for work taken elsewhere. Students who are in residence and are using the facilities of the University must register for such work.

## **Grading System**

The performance of students in graduate courses will be recorded by the instructor by use of the following grades:

**A Excellent**

This grade is given to those students whose performance in the course has been of very high graduate caliber.

**B Satisfactory**

This grade is given to those students whose performance in the course has been at a satisfactory level.

**C Fair**

This grade is given to those students whose performance in the course is not at the level expected in graduate work.

**F Failure**

This grade is given to those students whose performance in the course is unsatisfactory.

In addition, the following letter designations are used:

**I Incomplete**

This grade is given to those students who fail to complete the work of the course.

**L Audit without credit.**

**S Satisfactory without quality designation.**

**U Unsatisfactory without quality designation.**

These two grades are used for the first quarter of a two - quarter sequence in which the grade for the second quarter applies to both the first and second quarters of the sequence.

The I grade will be changed to a letter grade upon removal of the deficiency which caused the grade of I to be reported. Deficiencies must be made up within the quarter following that for which the grade of I is received unless an extension of time is granted by the instructor. However, such extension of time may not exceed two additional consecutive calendar quarters.

Any student who wishes to take a final make-up examination must obtain permission of the Director of the Graduate School by the second week of the quarter succeeding that in which the examination was missed. The



make-up examination must be taken in that succeeding quarter unless circumstances warrant permission of the Director to defer it to one of the next two quarters.

### **Auditing**

A student may audit a course without credit by obtaining, prior to registration, the written approval of the instructor of the course involved and by presenting this permit at the Office of the Graduate School of Education. No change either to or from the audit status may be made after the first day of classes. Tuition for an audit course is the same as for a course taken for credit.

### **Class Hours and Credits**

All credits are entered as quarter hours. A quarter hour of credit is equivalent to three-fourths of a semester hour credit. The academic calendar at the front of this bulletin should be consulted in order to determine the opening and closing dates of each quarter. It should be noted that most classes meet either in the late afternoon or evening.

### **Continuity of Program**

Students are expected to maintain continuous progress toward a degree. Any student who has been admitted to a degree program, has completed at least one course, but has not attended for a period of one year, must notify the Office of the Graduate School of Education prior to additional registration. In addition, he must meet with his program adviser to make any necessary program adjustments.

### **Withdrawals**

In order to withdraw from a course, a student must fill out an official withdrawal form obtained at the Registrar's Office or at the Burlington Campus Office. Withdrawals may be made through the ninth week of the quarter. Students will be withdrawn as of the date on which they fill out the form. Ceasing to attend a class or notifying the instructor does not constitute an official withdrawal. See section on financial information for information on refunds.

### **Changes in Requirements**

The continuing development of the graduate school forces frequent revision of curricula. In every new bulletin some improvements are indicated. When no hardship is imposed on the student because of changes, and when the facilities of the school permit, the student is expected to meet the requirements of the latest bulletin. If the student finds it impossible to meet these requirements, the bulletin for the year in which he entered becomes the binding one.

### **Application for the Degree**

If a commencement card is not filed with the Registrar's Office on or before the applicable date listed on the calendar, there is no assurance that the degree will be granted in that particular year even though all other requirements have been fulfilled.

### **Honor Society**

Northeastern University has on campus the Kappa Zeta Chapter of Kappa Delta Pi. A national honor society in education, Kappa Delta Pi was founded in 1911 at the University of Illinois. Kappa Zeta Chapter was installed on May 29, 1964.

To be considered for membership, graduate students must be degree candidates in the College of Education and have completed at least six courses (24 quarter hours) with a cumulative average of at least 3.5, and have no C grades on their graduate records.

Applications for membership and further information may be received from the Office of the Dean, College of Education, Northeastern University, Boston, MA 02115.

### **Supporting Services**

The College of Education operates or coordinates with other agencies in the operation of certain bureaus, clinics, and offices which support and enrich the academic programs. Graduate students may find some of these services to be of interest and assistance while others may be suggested as sources of information or practical experiences. Among these services are those discussed in the following paragraphs.

The Bureau of Educational Field Services, located in Cushing Hall (102 The Fenway), provides a wide variety of offerings to our graduate students as well as to school systems and other educational agencies throughout New England. These offerings include special off-campus programs for our graduate students, both credit and noncredit; credit and noncredit in-service training for professional school personnel, offered in local communities; special noncredit workshops for parent and para-professional groups; and program evaluation, research projects, surveys, educational planning services, and consultant services.

Anyone interested in obtaining more information about the Bureau should contact the Office of the Director of the Bureau at 617-437-3298, or visit 118 Cushing Hall.

Northeastern University's Speech and Hearing Clinic, located in 133 Forsyth Building, provides diagnostic and therapeutic services for both University students and school-age community children insofar as staff and facilities allow. The Clinic is accredited by the Professional Services Board of the American Speech and Hearing Association.

The Resources Laboratory (formerly the Curriculum Library), located in Cahnners Hall (104 The Fenway), contains a variety of materials and

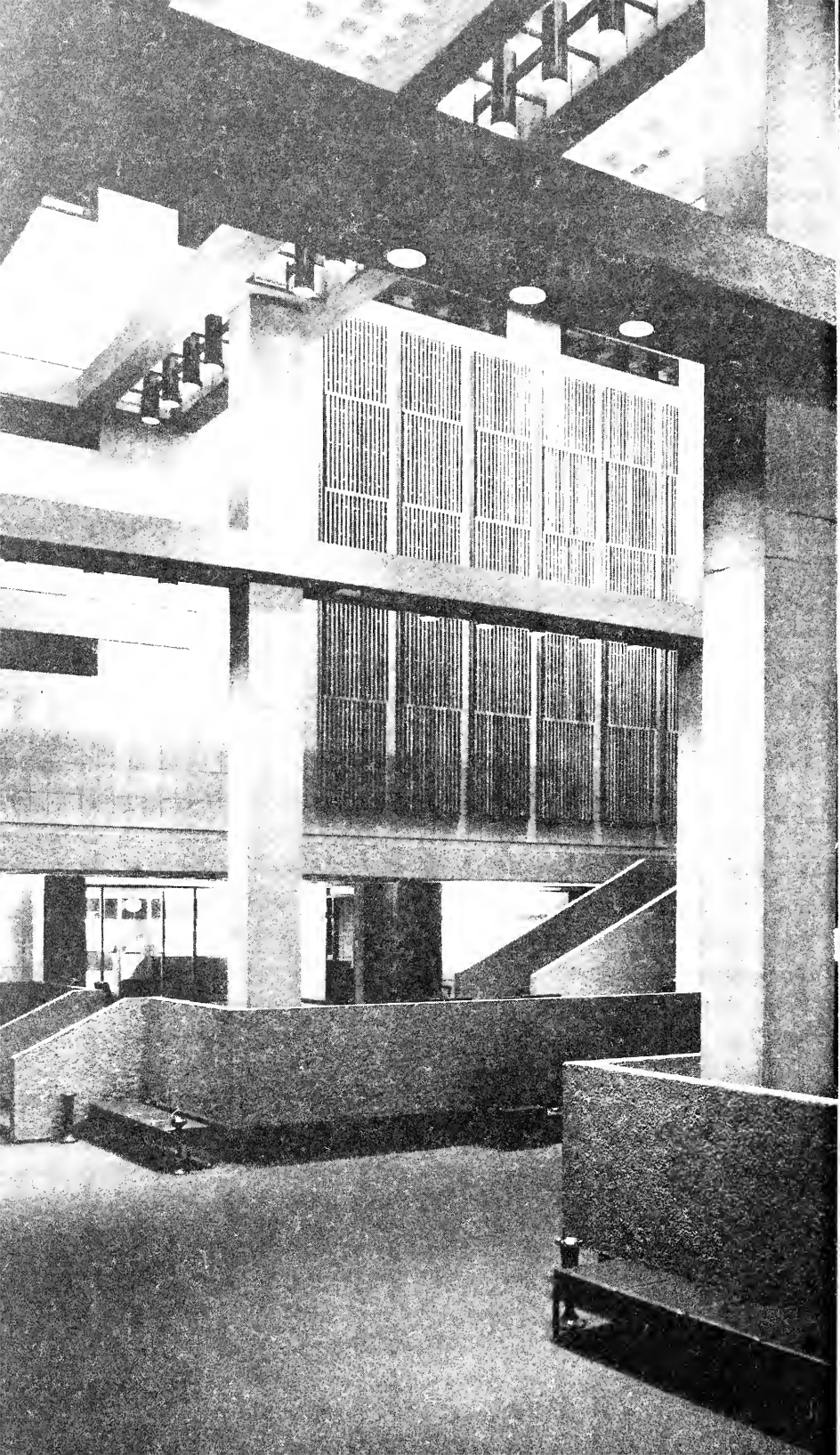
resources relating to a large number of programs and task areas of elementary and secondary schools. Use of this facility is limited to staff and students of the College of Education.

Northeastern University's Reading and Learning Clinic, located in Cahners Hall, provides diagnostic and corrective services in reading for both University students and school-age community children insofar as staff and facilities allow.

The New England Rehabilitation Research Institute, located in the United Realty Building, conducts rehabilitation studies on the problems of motivation and dependency and publishes reports pertaining to the area of rehabilitation. A materials resources library in rehabilitation research is housed in the same building as the Department of Rehabilitation and Special Education.

The Center for Educational Development, located in Cushing Hall, works with community agencies in developing and implementing innovative educational programs, particularly in areas, both urban and rural-isolated, which lack substantial financial resources.

In addition, the College of Education utilizes the resources, materials, and facilities of other University-wide bureaus such as the Office of Educational Resources, an important component of which is the Center for Programmed Instruction.



# financial information

## FINANCIAL OBLIGATIONS

### Tuition

Tuition for master's degree candidates, CAGS candidates, doctoral candidates, and special students is \$55 per quarter hour of credit. Tuition for audited courses is the same as for courses taken for credit. There is a special tuition charge of \$600 for the following: 51.805, Student Teaching; 51.873 and 51.875, Reading Clinic I & II; 53.805-806, Counseling Practicum; 53.840-841, Advanced Field Work; 53.843-844, School Psychology Field Work; 55.813, Advanced Clinical Practice; 56.850-851, Field Work and Student Teaching; 56.853-854, Field Work and Practicum; 56.960, Practicum in Rehabilitation Administration; 93.802-803, Practicum in Early Childhood Education I & II; Thesis; 55.852, Practicum, Teaching of the Deaf.

There is a special tuition charge of \$325 for the following: 52.843, Administrative Internship; Counselor Education Interns enrolled in the Boston School System.

The tuition charge for the doctoral dissertation is \$500, to be paid when registration is made for the dissertation. At the completion of formal course work for the doctorate, a dissertation continuation fee of \$50 per quarter will be charged until completion of the dissertation.

Tuition statements are mailed to students by the Bursar's Office and are payable by check to Northeastern University on or before the date specified.

Tuition rates and fees are subject to revision by the Board of Trustees at any time.

### Fees

An Application Fee of \$15 (nonrefundable) is charged to all students when they apply for admission to the Graduate School of Education. No application papers will be processed until this fee has been received. Checks should be made payable to Northeastern University and sent to the Graduate School of Education, 102 The Fenway, Boston, Mass. 02115.

Other fees include a charge of \$10 for late payment of tuition; a fee of \$2 for deferred tuition (with approval of Bursar); a final examination make-up fee of \$5; a fee of \$25 for all degree candidates, payable before commencement by the applicable date listed on the academic calendar.

For full-time students there is a charge of \$12.50 per quarter for the services available in the student center. The fee for teaching assistants and

research fellows is \$6.25 each quarter. All part-time students on the Huntington Avenue campus are charged \$.75 a quarter.

All full-time students, including those with assistantships and fellowships, will pay a nonrefundable university health services fee of \$120 each year. This fee will provide Blue Cross-Blue Shield coverage and entitle the student to the medical care furnished by the University Health Service.

All financial obligations to the University must be discharged before graduation.

### Refunds

Tuition refunds will be granted only on the basis of the date appearing on the official withdrawal form filed by the student. Nonattendance does not constitute official withdrawal. Questions regarding refunds should be discussed with the Bursar's Office.

Refunds will be granted in accordance with the following schedule:

Amount of Refund	
Official Withdrawal Filed Within:	Percentage of Tuition
First week of quarter	100
Second week of quarter	75
Third week of quarter	50
Fourth week of quarter	25

### FINANCIAL AID

The Office of Financial Aid offers two types of Federal assistance to graduate students: the National Direct Student Loan and Work-Study. All awards are based on financial need. Aid granted from these programs sponsored by the Federal Government is dependent upon the amount of funds allocated to Northeastern University.

Northeastern University is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form in order to be considered. This form may be obtained from the financial aid officer at the institution which the student now attends or from the Northeastern University Office of Financial Aid. All sections of the GAPSFAS form must be completed and sent to the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540. No decision on an application for financial aid will be made until the GAPSFAS form is received.

Only students who have been officially accepted as degree candidates to a graduate school of Northeastern University may apply for financial aid. The University does not award financial assistance to students who are not citizens or permanent residents of the United States.

### National Direct Student Loan

Under the National Direct Student Loan program, students may be allowed to borrow as much as \$2,500 per academic year; however, the total

amount borrowed must not exceed \$10,000 for the student's entire undergraduate and graduate program. Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load. The repayment of the principal may be extended over a ten-year period with an interest rate of 3% per annum.

### **College Work-Study Program**

The College Work-Study Program is sponsored by the Federal Government. It is designed to give students an opportunity to earn as much as \$3.50 per hour working in jobs on or off campus in public or private non-profit organizations. This program is administered solely by the Office of Financial Aid and is not to be confused with the University's cooperative education program.

### **Guaranteed Student Loan Program**

A prime means of financial assistance is the Guaranteed Student Loan Program. Because of the easy availability of this loan relative to other types of financial assistance, it is recommended that all applicants for aid first seek assistance from this source. Students may receive guaranteed loans of up to \$2500 per academic year from their local banks. Repayment of the principal and interest need not begin until nine months after the student ceases to carry at least a half-time academic load.

### **Martin Luther King, Jr., Scholarships**

Established in 1969 in memory of the late Rev. Martin Luther King, Jr. Awards are made as openings occur to qualified minority graduate students who show financial need and are accepted to full-time study in the graduate schools of the University. Stipends will cover tuition and all fees.

### **Dr. Reubin J. Margolin Memorial Scholarship Fund**

The Dr. Reubin J. Margolin Memorial Scholarship Fund was established in 1973 through the generosity of the family and friends of Dr. Reubin J. Margolin, an outstanding and dedicated individual and friend who, at the time of his death on April 6, 1972, was Chairman of the Department of Rehabilitation and Special Education at Northeastern University.

The income from the Dr. Reubin J. Margolin Memorial Scholarship Fund is awarded annually to a deserving student admitted to or enrolled in the College of Education or the Graduate School of Education and majoring in Rehabilitation and/or Special Education. Recipients must demonstrate financial need as well as the personal and professional qualities exemplified by Dr. Margolin.

The Office of Financial Aid does not award Graduate Assistantships or Fellowships. For further information regarding such assistance, students should contact their graduate school office.

### **Graduate Administrative Assistantships**

Some University departments offer the graduate student an opportunity for remission of tuition and a stipend in return for half time spent in assisting with nonteaching, administrative duties. In all cases the student must register for a half-time academic load. It is assumed that applicants for such assistantships will be enrolled in a two-year program.

### **Tuition Assistantships**

These appointments offer tuition waiver only. Graduate students given this type of appointment are assigned duties in the department requiring an average of 8 hours per week. They must register for a full-time academic load.

### **Teaching Assistantships**

Graduate students given this type of appointment assist in the work of instructional departments or other offices of the University. The appointee may be assigned to class instruction, laboratory supervision, correcting papers and proctoring examinations. Including necessary preparation time, assigned duties require about 18 to 20 hours per week.

The student must register for a half-time academic load. It is assumed that applicants for such assistantships will be enrolled in a two-year program.

### **Traineeships**

Graduate students given these appointments must devote full time to graduate work in accordance with the stipulation of the appointment. These appointments are made from traineeships available from NASA, NSF, NDEA, and other government grants to the University. They may be for 9 to 12 months.

### **Appointments**

Appointments to fellowships and assistantships are ordinarily announced no later than April 15 for the following academic year or summer. Appointments are for a maximum of one year and are not automatically renewed. Students who hold assistantships are expected to devote full time to their studies and the duties of the award. They may not accept outside employment without the consent of their faculty adviser and the Director of the Graduate School.

### **Dormitory Proctorships**

A number of proctorships in men's dormitories on or near the Huntington Avenue campus are available each year. Appointments carry a minimum compensation of room and board. Further information and application forms may be obtained from the Associate Dean of Students for Housing, 203 Ell Student Center.



# faculty

- Marvin Arffa, A.B., M.S., Ed.D., *Associate Professor of Education*  
Joseph C. Aurelia, B.A., M.A., *Assistant Professor of Speech Pathology and Coordinator of Clinical Services*  
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 Wilbert J. McClure, B.A., M.A., Ph.D., *Assistant Professor of Education*  
 JoAnne S. McKay, A.B., Ed.M., *Assistant Professor of Special Education*  
 Robert C. McLean, A.B., M.S., Ed.D., *Associate Professor of Education*  
 Joseph Meier, Ed.M., Ed.D., *Associate Professor of Education*  
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 Katherine M. Newman, B.S.Ed., O.T.R., Ed.M., C.A.G.S., *Instructor in Education*  
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- Stephen B. Ross, B.A., M.Ed., C.A.G.S., *Lecturer in Education*
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- Ray F. Saari, B.A., M.Div., M.S.W., *Lecturer in Education*
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- Barbara Schram, B.A., M.A., M.S.W., Ed.D., *Assistant Professor of  
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- James F. Scorzelli, B.S., M.A., Ph.D., *Assistant Professor of Education*
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- Kristine E. Strand, B.S., M.A., *Assistant Professor of Speech Pathology*
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- Paul H. Tedesco, A.B., A.M., Ph.D., *Associate Professor of Education*
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- Newton K. Von Sander, A.B, Ed.M., Ed.D., *Lecturer in Education*
- Dorothy A. Weber, B.A., M.Ed., *Assistant Professor of Special Education*
- Martin J. Wheeler, A.B., M.Ed., *Lecturer in Education*
- James W. Wilson, B.S., M.A., Ph.D., *Research Professor, Cooperative  
Education*
- Wesley G. Woll, B.S., M.D., *Lecturer in Education*
- Alvin D. Zalinger, B.S., M.A., *Associate Professor of Education*



# programs of the graduate school of education

## MASTER OF EDUCATION

### Professional Specializations

#### School and College Counseling Programs

- Elementary School Counseling

- Secondary School Counseling

- Career Education Specialist

- College Counseling

- Student Personnel

- Cooperative Education Coordinator

#### Community and Rehabilitation Counseling Programs

- Community Mental Health Counseling

- Rehabilitation Counseling

- Community Services Counseling

#### Curriculum and Instruction

- English-Language Arts

- General Academic

- Reading

- Science-Mathematics

- Social Studies

#### Early Childhood Education

- Administration

- Teaching

#### Educational Administration

- Elementary and Secondary Administration

- Instructional Technology

- Occupational Education

#### Educational Research

#### Human Development

#### Rehabilitation Administration

#### Special Education

- Emotional Disturbance—Learning Disabilities

- Generic Special Educator

- Mental Retardation—Learning Disabilities

- Severely Handicapped

- Early Childhood Handicapped

- Special Education Community Personnel

#### Speech Pathology and Audiology

- Audiology

- Speech Pathology

- Teaching the Deaf

**Nondegree Program for Certification  
of Elementary and Secondary Teachers**

**CERTIFICATE OF ADVANCED GRADUATE STUDY (CAGS)**

**Counselor Education**

Pupil Personnel Services Administration

School Psychology

Counseling

School

College

Community Mental Health

Rehabilitation

**Educational Administration**

Cooperative Education

Educational Administration

Higher Education

Instructional Technology

Rehabilitation and Special Education Administration

**DOCTOR OF EDUCATION**

**Counselor Education**

Pupil Personnel Administration

Student Personnel Administration

**Educational Administration**

Administration of Cooperative Education

Administration of Higher Education

School Administration

**Rehabilitation and Special Education**

Rehabilitation Administration

Special Education Administration

**MASTER OF EDUCATION DEGREE**

**Admission to Degree Candidacy**

An applicant must have earned a bachelor's degree from an accredited institution and must complete all admissions procedures as described.

An applicant for graduate study in a master's degree program or a CAGS program should have all of the following material on file in the office of the Graduate School of Education three weeks (two months for full-time) prior to the beginning of classes in any given quarter. (Applicants for programs in Counselor Education and Special Education must have all material on file by April 15.)

1. Two completed application forms.
2. Two official transcripts from all colleges or universities attended.
3. References as follows:

- a. If no teaching experience, three letters of recommendation from individuals acquainted with the applicant's scholastic, professional, or intellectual ability.
- b. If teaching experience (beyond student teaching), one reference from the current or most recent supervisor.
4. An official copy of the Miller Analogies Test score (MAT).
5. Graduate Record Examination scores (aptitude test only) for applicants with 25% or more pass-fail grades.
6. For CAGS applicants, a record of an interview with the chairperson of the department to which they are applying.
7. For applicants whose native language is not English, an official copy of the results of the Test of English as a Foreign Language (TOEFL).

The Graduate School of Education may require a preadmission conference with any applicant. Applicants may at any time request a conference with the Director of the Graduate School of Education or his designate.

### **Application Fee**

All applications for admission must be accompanied by an application fee (nonrefundable) of \$15. No application will be processed until the fee has been received by the Graduate School of Education. Checks should be made payable to Northeastern University and sent to the Graduate School of Education, 102 The Fenway.

### **Confirmation**

Applicants must confirm their acceptance to a program within the designated period of time. If confirmations are not received, places in the program will be offered to other applicants.

Students who have confirmed their acceptance to a program but who have not initiated their programs within four quarters of admission will be withdrawn from the Graduate School of Education.

### **Full-time Study**

A full-time student must take three courses in all quarters except the summer session, during which he must take a minimum of two courses. Enrollment in an additional course in any quarter must be approved by the adviser.

### **Part-time Study**

A part-time student may enroll in a maximum of two courses in any given quarter.

### **Program Selection and Registration**

Upon acceptance as a degree candidate, the student will be assigned an adviser in his major area of study. After notification of acceptance by the

Graduate School of Education, the student must confer with the adviser regarding his program of studies and initial course registration. The student's initial program and any subsequent changes may develop only as a result of the written recommendation of the adviser.

Initial registration will be allowed only upon presentation of a "Permit to Register" card.

### **Special Student Status**

Applicants who have earned a bachelor's degree from an accredited institution and who acknowledge that they do not wish to pursue a degree may be accepted as special students. Special students may register for a maximum of three courses, one per quarter, provided that they submit an application form, accompanied by an application fee of \$15, and an official transcript, three weeks prior to the beginning of classes. Academic credit earned in such study may not be used to fulfill degree requirements in the Graduate School of Education unless the applicant is accepted as a degree candidate and the courses are applicable to his program. Special students may be considered for degree candidacy only upon full presentation of application materials and a formal petition to the Director of the Graduate School of Education.

### **Academic Classification**

1. *Regular* Applicants who meet in full the criteria for immediate matriculation are classified as regular students.
2. *Provisional* Some applicants who do not meet regular admissions standards may be admitted as provisional students. Such students must maintain a B average in their first twelve quarter hours of work in order to continue in the graduate program. Provisional students admitted for part-time study may take only one course in their first quarter of study.
3. *Special* See above.

### **Programs of Study**

The curricula of the programs for the Master of Education degree are given on pages 46-75.

Programs are available for students with or without regular teaching certification. Those with certification may major in the professional specializations listed on page 46.

Students without certification may pursue a Master of Education degree program for which certification is not mandatory (as indicated on page 46) or if able to devote full time to graduate study, may apply for a combined program as described on page 76.

A nondegree certification program for elementary and secondary teachers is available as described on page 75.



**Comprehensive Examination**

A comprehensive examination may be required by a department. Unsatisfactory performance in such an examination constitutes grounds for withholding the degree.

**Academic Requirements**

In order to qualify for the Master's Degree in Education, an average grade of B must be obtained in all courses. No additional course credits may be allowed in order to satisfy the B average required for the degree.

No student who receives a grade of less than B in three or more courses will be permitted to continue in the program. A student who has accumulated two grades of C from the same faculty member may not register for a third course with this faculty member.

A student who receives a grade of F in a course must make up the course in accordance with the recommendation of his adviser. A student who receives a grade of F in two courses will not be permitted to continue in the program.

**Credit and Course Requirements**

In satisfying the requirement for a minimum of 40 quarter hours, a student's program must include at least 12 courses which apply to the degree.

**Transfer Credits**

A maximum of 12 quarter hours of credit obtained at another institution may be accepted toward the master's degree provided that the credits are recommended for transfer by the student's adviser, consist of work taken at the graduate level for graduate credit, carry grades of A or B, have been earned at an accredited institution, and have not been used toward any other degree. Students should petition the Director of the Graduate School in writing for all transfer credit by completing the necessary form, obtainable from either the office of the Graduate School of Education or the faculty adviser. The completed form must be submitted to the Director of the Graduate School of Education along with an official transcript and an excerpt from the catalog describing the course.

No transfer form will be considered complete without the signature of the student's adviser or department chairperson. Grades on transfer credits may not be used for the purpose of obtaining the academic average necessary for completion of the degree requirements.

**Time Limitations**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years.

## **NONDEGREE PROGRAM FOR CERTIFICATION OF ELEMENTARY AND SECONDARY TEACHERS**

### **Admission**

Applicants for this program must follow the admissions procedures as described on page 38 and meet the admissions requirements for the Master of Education degree. In addition, applicants whose backgrounds may not include an approved course in such areas as human development or learning must take such a course either before they enter the program or before student teaching. Candidates for secondary certification must have completed, before admission, at least 36 quarter hours of courses in the field in which they are preparing to teach, with a QPA for all courses taken in that field of at least 2.000.

### **Academic Requirements**

In order to qualify for Student Teaching, students must have completed the four required courses with a B average, and be recommended by their major adviser.

A student may repeat a course in which he has received a grade of C or F, and the second grade will govern. However, only one course may be repeated on this basis.

## **CERTIFICATE OF ADVANCED GRADUATE STUDY (CAGS) PROGRAM**

### **Admission**

An applicant for the Certificate of Advanced Graduate Study in Counselor Education, Educational Administration, and Rehabilitation and Special Education must hold a master's degree from an accredited institution and file supportive materials in accordance with guidelines which will be provided upon request. Inquiry, specifying the program for which information is sought, should be addressed to the Director of the Graduate School of Education.

Applicants for CAGS programs must have application materials on file in the office of the Graduate School of Education three weeks (two months for full-time) prior to the beginning of classes in any given quarter.

### **Academic Requirements**

In order to qualify for the Certificate of Advanced Graduate Study, an average grade of B must be obtained in all courses. No additional course credits may be allowed in order to satisfy the B average required for the certificate.

No student who receives a grade of less than B in three or more courses will be permitted to continue in the program. A student who has accumulated two grades of C from the same faculty member may not register

for a third course with this faculty member.

A student who receives a grade of F in a course must make up the course in accordance with the recommendation of his adviser. A student who receives a grade of F in two courses will not be permitted to continue in the program.

### **Transfer Credits**

See requirements under master's degree on preceding pages.

### **Time Limitations**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years.

### **Qualifying and Comprehensive Examinations**

Students may be required to take a qualifying examination. All students are required to satisfactorily complete a comprehensive examination in order to qualify for the Certificate of Advanced Graduate Study.

## **DOCTOR OF EDUCATION DEGREE**

### **Admission**

Applicants for admission to the Doctor of Education degree program must file evidence of a master's degree or its equivalent from an accredited institution and such other materials as required by the Graduate School of Education. Materials will be accepted from applicants who are currently enrolled in graduate studies and who expect to obtain the master's degree within two terms of the time of application.

Students who have graduated from or are currently enrolled as regular CAGS students in the Graduate School of Education may apply for the doctoral degree program. Although most CAGS course work is applicable, there are different admissions criteria and formal application must be made. Conversely, regular doctoral students who either choose not to complete the doctoral program or are disqualified from continuing, may make formal application to transfer to the CAGS program.

As part of the application procedure, the applicant must declare a major field of specialization, submit a written statement of purpose for pursuing doctoral study, and if requested, meet with an admissions committee for further evaluation. Applications to the Doctor of Education degree program will be acted upon twice yearly, for September or March (Fall or Spring Quarter matriculation). Application materials must be completed at least a quarter prior to the time the student is seeking admission or the candidate's application will automatically be forwarded for inclusion in the next action period. Within this period candidates will be informed of their admission status as soon as possible.

### **Classification and Degree Candidacy**

Students taking advanced graduate work are classified as follows:

1. **Doctoral Student**  
Students in this classification have been accepted for doctoral study, but have not yet passed the qualifying examination.
2. **Doctoral Degree Candidates**  
Students in this classification have completed forty-eight quarter hours of graduate work and have passed the qualifying examination.

### **Academic Requirements**

In order to qualify for the Doctor of Education degree, an average grade of B must be obtained in all courses. No additional course credits will be allowed in order to satisfy the B average for the degree. No student who receives a grade of less than B in three or more courses will be permitted to continue in the program. A student who has accumulated two grades of C from the same faculty member may not register for a third course with this faculty member. A student who receives a grade of F in a course must make up this course in accordance with the recommendation of the adviser. A student who receives a grade of F in two courses will not be permitted to continue in the program.

### **Qualifying Examination**

A qualifying examination must be taken by each doctoral student seeking degree candidacy. The purpose of the examination is to evaluate the student's general understanding of the field of specialization. The qualifying examination must be taken before the completion of forty-eight quarter hours of doctoral study.

### **Comprehensive Examination**

After completion of all formal course work, the doctoral degree candidate must satisfactorily demonstrate, by means of a comprehensive examination, breadth and depth of knowledge in the area of specialization, as well as general professional understanding and comprehension of major issues in related fields.

### **Dissertation**

As part of the degree program, each candidate must complete a dissertation which embodies the results of extended, creative, independent research and proper evaluation and interpretation of the results. A Dissertation Committee, made up of a major adviser and at least two other faculty members, must approve the dissertation.

**Final Oral Examination**

The final oral examination will be taken after completion of all other requirements for the doctoral degree. The examination will be held at least three weeks before the Commencement at which the degree is to be awarded and the results of the examination will be made available immediately to the student.

The substance of the final oral examination will include the subject matter of the doctoral dissertation and significant developments in the area of the student's specialization.

**Transfer Credit**

In satisfying the course requirements beyond those required for the master's degree, the adviser may recommend to the Committee of the Graduate School of Education transfer credit up to a maximum of twenty-five percent of such course requirements.

**Time Limitation**

After admission to degree candidacy, a maximum of five years will be allowed for completion of the degree requirements. Any extension of this time must be approved by the Committee of the Graduate School of Education.

**Financial Aid**

A limited amount of financial aid is available. Inquiries regarding this matter should accompany application.

# fields of study

## PROGRAMS IN PROFESSIONAL SPECIALIZATIONS

### Master of Education

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All students must complete one of the programs as outlined below. In most cases, the sequence is designed to be very flexible. Any variations or changes must have the prior recommendation of the major adviser and approval of the Director of the Graduate School of Education.

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\*Teaching certification not mandatory.

## MASTER OF EDUCATION CORE REQUIREMENT

### Required of all candidates:

#### *Area I — Research*

##### 50.815 Research Design in Education

Entrance into this course must be preceded by satisfactory completion of a proficiency examination in statistics administered by the Center for Programmed Instruction or by satisfactory completion of 50.841 Introduction to Educational Statistics. *Important:* 50.815 must be included among the first six courses taken by each student. (See further information under the 50.815 course description.)

### All candidates must complete at least one course in each of two of the following areas:

#### *Area II — Psychological Foundations*

##### 50.803 Child Psychology

##### 50.804 Adolescent Psychology

These two courses are intended for students with no previous background in psychology.

##### 50.806 Psychology of Learning

##### 50.810 Psychology of Personality

##### 50.811 Psychology of Thinking

It is strongly recommended that entrance into any of these courses be preceded by a course in psychology.

##### 50.808 Seminar in Child Development

Entrance into this course *must* be preceded by a course in child psychology or human development.

##### 50.809 Seminar in Adolescent Development

Entrance into this course *must* be preceded by a course in adolescent psychology or human development.

##### 50.850 Communications Theory

#### *Area III — Social Foundations*

##### 50.801 Educational Anthropology

##### 50.802 Sociology of Education

These two courses are intended for students with no previous background in sociology and anthropology.

##### 50.805 Personality and Social Structure

It is strongly recommended that entrance into this course be preceded by a course in sociology, cultural anthropology, or social psychology.

##### 50.820 Seminar in Contemporary Issues in American Education

#### *Area IV — Humanistic Foundations*

##### 50.812 History of Education

##### 50.818 Comparative Education

##### 50.822 Topics in the Philosophy of Education

## PROGRAMS

### Counselor Education

#### *General Information*

The Department of Counselor Education offers several concentrations within two major program clusters: School and College Counseling and Community and Rehabilitation Counseling. Each of the concentrations in these clusters is described on the following pages. Prospective students should apply to one of the two clusters.

The master's degree requirements may be completed by full-time students in four quarters or one calendar year. However, the Department considers these programs to be minimal and urges most students to take an additional year of study leading to the CAGS.

The practicum sequence (53.805-53.806) including the concurrently required counseling course (53.804) is offered only on a sequential basis beginning in the fall quarter. Part-time students may not begin this sequence until their second year of study. They must apply for practicum placement by April 1 of the spring preceding practicum placement.

Full-time students (eligible for practicum) will be asked to complete a practicum application either at the time of their group interview or immediately upon acceptance. In general, students should expect to spend two days (or twelve hours) weekly at their practicum sites between October 1 and June 15. Placements are made by matching student interests and experience with practicum site availability. Field site supervisors have the option of accepting or rejecting recommended students for placement in their setting. Arrangements for practicum site placement will be completed, in general, by August 1.

Some students, with special permission, may be able to use their place of employment as a practicum site provided arrangements for supplementary experience are made with their advisers.

Candidates for admission to summer and fall quarters must complete application materials no later than the preceding April 15. After the application materials are submitted, applicants will be notified by mail of dates for small group interviews with other candidates and college staff. Acceptance decisions for both part-time and full-time applicants will be mailed between April 1 and May 31.

#### *Internships — Financial Aid*

No financial aid in the form of scholarships or grants is available to students through the Department. Students should consult the Financial Aid Office of the University for information as to what is available to graduate students. However, the Department does try to develop paid Internships in various work settings as both a means to ease the financial burden and to provide a more extensive work experience. The numbers of internships are limited, and they are not necessarily available in all



programs. Their availability is entirely dependent on the interest and ability of schools or agencies to make money available for an internship position.

The opportunity for professional development makes the Internship especially attractive, and any interested student is encouraged to apply. No placements can be guaranteed, however. Applications for internships and additional information are available from the Department of Counselor Education or from the Graduate School Admissions Office.

### *Core Curriculum Requirements*

In addition to three Foundations of Education core requirements described on page 47, all program choices in the Department have a common core of required courses as follows:

- 53.800 Philosophical Foundations of Guidance and Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 Counseling Practicum

One of the following:

- 53.813 School Counseling Strategies
- 53.814 Vocational Counseling Strategies
- 53.815 Rehabilitation Counseling Strategies
- 53.816 Psychological Counseling Strategies

The Counseling Practicum is always specific to the particular concentration to which the student has been admitted. These core requirements constitute nine of the twelve courses required for the master's degree. The remaining three courses will be selected in consultation with the adviser. These course selections must be approved by the adviser prior to registration.

### **School and College Counseling Programs**

Program concentrations in this cluster include preparation for positions in elementary school counseling, secondary school counseling, career education, college counseling, student personnel, and cooperative education.

#### *Elementary Counseling Program*

The Elementary School Counseling Program prepares students to: 1) help children to grow in self-understanding and in positive fuller use of potential; 2) help parents to understand the developmental needs of all pupils and work with parents to meet the individual needs of their own children in the school situation; 3) participate in creating a school environment conducive to learning and growth for all children; and 4) participate in curriculum development and change. The training focuses on developing competencies in individual counseling, group counseling, consulting,

testing, and parent counseling. Students are prepared to work with children, parents, and teachers in schools and related settings.

Elementary Counseling Practicum placements are made in a variety of urban and suburban elementary schools and in child guidance clinics.

Sample Program for Elementary Counseling Program:

Departmental Requirements

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (01) Practicum in Elementary Counseling I, II

Specialized Courses

- 53.810 Elementary School Guidance
- 53.813 School Counseling Strategies
- 53.824 Individual Intelligence Testing

Required Foundations Core Course

- Area I 50.815 Research Design in Education

Recommended Foundations Core Courses

- Area II
  - 50.806 Psychology of Learning or
  - 50.810 Psychology of Personality or
  - 50.808 Seminar in Child Development
  - 50.807 Abnormal Psychology
- Area III
  - 50.802 Sociology of Education or
  - 50.805 Personality and Social Structure or
  - 50.820 Seminar in Contemporary Issues in American Education

Electives (Choose one)

- 53.808 Group Counseling or
- 53.811 Family and Parent Counseling or
- 56.807 Learning Disabilities

*Secondary Counseling Program*

The Secondary School Counseling Program assumes that there are things which the school counselor can do to make the school a better place in which to learn and to teach. Various ways in which the guidance person can work with pupils, parents, teachers, administrators, and community agencies as a counselor, as a consultant, and as a coordinator are emphasized. The focus of the program is on the practical background knowledge and the specific skills the counselor needs for helping students to learn more effectively, to make decisions more maturely, and to achieve personal fulfillment more completely.

Secondary Counseling practicum placements are made in a variety of urban and suburban secondary schools and school outreach programs.

Sample Program for Secondary Counseling Program:

Departmental Requirements

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (02) Practicum in Secondary Counseling I, II

Specialized Courses

- 53.802 Vocational Development and Occupational Information
- 53.813 School Counseling Strategies

Required Foundations Core Courses

- Area I 50.815 Research Design in Education

Recommended Foundations Core Courses

- Area II 50.806 Psychology of Learning or
- 50.810 Psychology of Personality or
- 50.809 Seminar in Adolescent Development
- 50.807 Abnormal Psychology
- Area III 50.802 Sociology of Education or
- 50.805 Personality and Social Structure or
- 50.820 Seminar in Contemporary Issues in American Education

Electives (Choose two)

- 53.808 Group Counseling
- 53.811 Family and Parent Counseling
- 53.814 Vocational Counseling Strategies
- 56.807 Learning Disabilities

*Career Education Program*

The Career Education Program is designed to prepare students for a variety of counselor-type roles within the career education orientation. These newly emerging roles within the broad field of career education encompass three specific dimensions of training: 1) the organization and utilization of career information as a resource; 2) the development of job placement—job counseling skills; and 3) the innovation of appropriate curriculum practices and revisions. The program is designed so that at the practicum phase of their training students can be placed in field settings where they can obtain actual experience in all three of these dimensions of career education. This program is intended for students who have experience and/or an interest in working with school-age youth — grades kindergarten to twelve — in the area of career development and work placement.

Career Education Specialist Practicum placements are made in both comprehensive and vocational-technical schools where there is an emphasis on career education and/or work-study type programs.

Sample Program for Career Education Specialist:

Departmental Requirements

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (03) Career Education Practicum I, II

Specialized Courses

- 53.802 Vocational Development and Occupational Information
- 53.814 Vocational Counseling Strategies
- 52.816 Seminar in Career Education

Required Foundations Core Course

- Area I 50.815 Research Design in Education

Recommended Foundations Core Courses

- Area II
  - 50.806 Psychology of Learning or
  - 50.810 Psychology of Personality or
  - 50.809 Seminar in Adolescent Development
- Area III
  - 50.802 Sociology of Education or
  - 50.805 Personality and Social Structure or
  - 50.820 Seminar in Contemporary Issues in American Education

Electives (Choose one)

- 53.807 Administration of Guidance Services
- 53.808 Group Counseling
- 53.813 School Counseling Strategies

*College Counseling and Student Personnel Services Program*

Preparation for both college counseling and student personnel positions is similar and based on the assumption that the student personnel worker must have the human relations skills of the counselor, and the counselor must have an understanding of both the learning development needs of students and the instructional environment of the college setting. Graduates will have a basic knowledge of vocational development and career planning, information-gathering, interviewing techniques, decision-making strategies, and group process. Students may then choose to emphasize the counseling role in the counseling center or the student personnel role, which is more programmatic, within the institution. Practicum placements can be varied to suit individual interests. Positions for graduates may include counseling in junior colleges or residence halls; counseling in financial aid, student activities, or admissions offices; or that of assistant to a dean of students.

College Counseling and Student Personnel Practicum placements are made in a variety of junior college, college, and university settings in the Greater Boston area. In addition to counseling center placements, there are

placements in residence halls, financial aid offices, and other student personnel program offices. Placements are also made in such higher education related settings as the Center for Alternative Education, a personal development program.

**Sample Program for College Counseling Program:**

**Departmental Requirement**

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory & Process
- 53.805-53.806 (04) College Counseling Practicum I, II

**Specialized Courses**

- 53.809 The College Student and The Campus
- 53.814 Vocational Counseling Strategies or
- 53.816 Psychological Counseling Strategies

**Required Foundations Core Course**

- Area I 50.815 Research Design in Education

**Recommended Foundations Core Courses**

- Area II 50.810 Psychology of Personality or
- 50.809 Seminar in Adolescent Development
- 50.807 Abnormal Psychology
- Area III 50.805 Personality and Social Structure or
- 50.820 Seminar in Contemporary Issues in American Education

**Electives (Choose three)**

- 53.814 Vocational Counseling Strategies or
- 53.816 Psychological Counseling Strategies
- 53.808 Group Counseling
- 53.802 Vocational Development and Occupational Information
- 53.811 Family and Parent Counseling

**Sample Program for Student Personnel Services Program:**

**Departmental Requirements**

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory & Process
- 53.805-53.806 (05) Student Personnel Practicum I, II

**Specialized Courses**

- 53.809 The College Student and The Campus
- 53.814 Vocational Counseling Strategies
- 53.812 Seminar in Student Personnel Work

## 54 / FIELDS OF STUDY

### Required Foundations Core Course

Area I    50.815    Research Design in Education

### Recommended Foundations Core Courses

Area II    50.810    Psychology of Personality or  
              50.809    Seminar in Adolescent Development  
              50.807    Abnormal Psychology

Area III    50.805    Personality and Social Structure or  
              50.820    Seminar in Contemporary Issues in American  
                          Education

### Electives (Choose one)

52.864    Typologies of Higher Education

52.868    The Community College

### *Cooperative Education Program*

The rapid expansion of cooperative education programs in higher education throughout the United States has increased the need for trained persons to staff the centers that coordinate and operate these programs. Northeastern University is the largest cooperative education institution in the world, and as such, can provide an excellent opportunity for the student interested in this aspect of higher education. At the master's level the preparation emphasizes a counseling base because the coordinator's prime role involves student contact. The three major elements in the coordinator's role are 1) vocational decision-making counseling; 2) work placement and work evaluation; and 3) curriculum development within the institution. The coordination function involves providing links between the student and his educational program, and the employer and his work setting. These two elements are combined to produce a total educational experience for the student. Preparation beyond the master's degree can lead to careers in student personnel, counseling, higher education administration, or cooperative education administration.

Cooperative Education Coordinator placements will be made in the Division of Cooperative Education, Northeastern University, and in other colleges and junior colleges in the area that have or are developing cooperative education programs.

### Sample Program for Cooperative Education Specialist:

#### Departmental Requirements

53.800    Philosophical Foundations of Guidance &  
                  Human Services

53.801    Tests and Test Procedures

53.804    Counseling Theory & Process

53.805-53.806 (06) Cooperative Education Practicum I, II

Specialized Courses

- 53.802 Vocational Development and Occupational Information
- 53.809 The College Student and The Campus
- 53.814 Vocational Counseling Strategies
- 52.824 Administration of Cooperative Education

Required Foundations Core Course

- Area I 50.815 Research Design in Education

Recommended Foundations Core Courses

- Area II 50.806 Psychology of Learning or
- 50.809 Seminar in Adolescent Development or
- 50.810 Psychology of Personality
- Area III 50.802 Sociology of Education or
- 50.805 Personality and Social Structure or
- 50.820 Seminar in Contemporary Issues in American Education

Electives (Choose one)

- 53.808 Group Counseling
- 53.816 Psychological Counseling Strategies

**Community Mental Health, Community Services, Rehabilitation Counseling Programs**

This cluster provides applied training in three programmatic areas of study: Community Services Counseling (preventive mental health), Rehabilitation Counseling and Community Mental Health Counseling. These programs emphasize three aspects of professional development: field-based training, didactic learning and personal growth. Field-based training is accomplished through extensive practicum work in clinics and agencies in the metropolitan Boston area; didactic learning occurs in graduate courses and practicum supervision on campus and in the field. Personal growth is encouraged through consultation with program advisers, field supervisors and in group counseling courses.

*Community Services Program*

The Community Services counseling program is designed to prepare students to work in a variety of human services agencies providing preventive mental health, informational, supportive and recreational services for broad segments of the population regarded as behaving normally. Much of the work could be categorised as preventive community health. Graduates will have a basic knowledge of vocational development and career planning, information-gathering, interviewing techniques and decision-making strategies. They will have a knowledge of psychometrics, adolescent and adult personality development, procedures in educational and vocational placement and the utilization of multiple helping agencies in meeting clients' needs. They will have skills in individual and small group counseling and decision-making procedures.

Community Services Counseling practicum placements will include state offices of the Division of Employment Security, Manpower Training Programs, Model Cities Programs, YMCA, YWCA, Boys' Clubs, Girls' Clubs, recreational facilities, community centers, drop-in centers, Youth Activities Commission, and career planning agencies.

**Sample Program for Community Services Counseling Program:**

**Departmental Requirements:**

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (07) Community Services Practicum I, II

**Specialized Courses:**

- 53.814 Vocational Counseling Strategies
- 53.808 Group Counseling

**Required Foundations Core Course:**

- Area I 50.815 Research Design in Education

**Recommended Foundations Core Courses**

- Area II 50.810 Psychology of Personality or  
50.809 Seminar in Adolescent Development or  
50.807 Abnormal Psychology
- Area III 50.805 Personality and Social Structure

**Electives (Choose two):**

- 53.802 Vocational Development and Occupational Information
- 52.816 Seminar in Career Education
- 53.816 Psychological Counseling Strategies
- 56.956 Community Planning in Rehabilitation

*Rehabilitation Counseling Program*

The Rehabilitation Counseling program is designed to prepare students to deliver comprehensive services to disabled and handicapped populations with the ultimate objective of improving the nature of their social, family, and personal functioning. The population to be served includes the physically handicapped, mentally ill, mentally retarded, alcohol and drug addicted, chronically dependent, and penal offenders. Graduates of this program will be generally familiar with the nature of physical, mental, and social handicaps; with the existing rehabilitative services through work experiences, field visits, reading and discussions with agency personnel; with the elements of rehabilitation operations, including systematic evaluation, individual counseling, planning for additional needed examinations and services, planning for training, vocational planning and placement, and follow-up services in the community.



Rehabilitation counseling practicum placements are made in community workshops for the physically handicapped, mentally ill, mentally retarded; workshops and half-way houses for drug addicts, alcoholics, and penal offenders; rehabilitation centers in mental hospitals, schools for mentally retarded and correctional institutions; rehabilitation programs for dependent persons in the welfare department and in the Massachusetts Rehabilitation Commission.

Sample Program for Rehabilitation Counseling Program:

Departmental Requirements

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (08) Rehabilitation Counseling Practicum I, II

Specialized Courses

- 53.815 Rehabilitation Counseling Strategies
- 56.950 Introduction to Rehabilitation
- 56.951 Medical Rehabilitation

Required Foundations Course

- 50.815 Research Design in Education

Recommended Foundations Core Courses

- Area II 50.810 Psychology of Personality or  
50.807 Abnormal Psychology
- Area III 50.805 Personality and Social Structure

Electives (Choose one)

- 53.808 Group Counseling
- 53.811 Family and Parent Counseling
- 56.983 Rehabilitation of the Alcoholic and Drug Dependent
- 56.984 Rehabilitation of the Penal Offender

*Community Mental Health Counseling*

The Community Mental Health Counseling program is designed to prepare students to assist in the delivery of comprehensive mental health services to individuals, families and groups experiencing personal, developmental and social problems. Graduates will be introduced to the major approaches to individual, group, marriage and family counseling. They will have some knowledge of important environmental effects on the behavior of various client populations. Because of the comprehensive nature of the community mental health field, students seeking admission to this program should give serious consideration to a two-year commitment or its equivalent leading to the completion of both a M.Ed. degree and a Certificate of Advanced Graduate Study.

Community Mental Health Counseling practicum placements are made in out-patient clinics, in-patient facilities, community mental health centers, city hospitals having family counseling services, state mental hospitals, drop-in centers, career planning agencies, adolescent counseling programs, street-work and out-reach counseling programs.

Sample Program for Community Mental Health Counseling Program:

**Departmental Requirements**

- 53.800 Philosophical Foundations of Guidance & Human Services
- 53.801 Tests and Test Procedures
- 53.804 Counseling Theory and Process
- 53.805-53.806 (09) Community Mental Health Practicum I, II

**Specialized Courses**

- 53.816 Psychological Counseling Strategies
- 53.808 Group Counseling
- 53.811 Family & Parent Counseling
- 53.831 Advanced Group Counseling

**Required Foundations Core Course**

- Area I 50.815 Research Design in Education

**Recommended Foundations Core Courses**

- Area II 50.807 Abnormal Psychology or
- 50.808 Seminar in Child Development or
- 50.809 Seminar in Adolescent Development
- Area III 50.805 Personality and Social Structure

**Electives (Choose one)**

- 56.956 Community Planning in Rehabilitation
- 53.818 Case Studies in Marriage and Family Counseling
- 53.830 Seminar in Contemporary Issues in Counseling

**Curriculum and Instruction (Including Programs in Reading)**

The programs in Curriculum and Instruction are appropriate for certified or experienced teachers who wish to prepare for instructional leadership and curriculum development responsibilities, who wish to expand their professional backgrounds in subject matter or pedagogy, or who wish to achieve reading certification.

This program will enable its graduates:

- (1) to view the educational process as an ongoing activity embodying both continuity in each of its parts and inter-relatedness among its parts;
- (2) to plan and institute learning activities which promote continuity and inter-relatedness;
- (3) to evaluate and modify appropriately existing programs and practices in their special fields;

- (4) to identify educational needs, analyze them, and develop suitable plans to meet them;
- (5) to institute desired changes in educational practice.

The following roles are some of those for which graduates of the program will be prepared:

- (1) specialist in a particular content area, such as reading, mathematics, science, social studies, English-language arts, at one or more levels — elementary, secondary, or adult education;
- (2) curriculum specialist in a variety of educational settings;
- (3) instructional specialist such as team leader, conductor of workshops, master teacher, and so forth, in a school or other educational setting.

The Master of Education in Curriculum and Instruction is divided into four basic areas of study:

1. Master of Education Core
2. Curriculum and Instruction Core

The Curriculum and Instruction Core consists of two sequential courses which individually and together emphasize a unitary view of the processes of curriculum development and instructional practices at all levels of education and in all school subjects. The Curriculum and Instruction Core is taught jointly by members of the Department, and students have the unique opportunity of studying with a wide range of faculty, each contributing his individual expertise and perspective within the context of the common purpose.

3. Specialization

A specialization consists of a number of courses constructed around a broad area through which students can pursue their specific interests while at the same time keeping sight of larger contexts. The courses are taught jointly by members of the Department of Curriculum and Instruction, grouped according to the commonalities among their subjects, thus giving students the opportunity to work within a context which, while recognizing the discreteness of a subject, at the same time encourages recognition of what this subject shares with its fellows in its area.

Students will normally select one area of specialization from those listed below, depending upon their background and interests. Students whose interests lie outside the above areas will be permitted to design, with their advisers, a program to meet their needs. Students seeking reading certification will fulfill the state requirements by completing the courses in the Reading specialization.

4. Electives

The elective portion of the Curriculum and Instruction Program will enable students to pursue other areas of interest which will complement or extend their area of specialization. Electives can be selected broadly from the offerings of the Graduate Schools of the University.

*Specimen Programs*

Master of Education Core

Three courses as defined on page 47.

Curriculum and Instruction Core\*

51.880 Evolution and Revolution in the School Curriculum

51.881 The Dynamics of Innovation in Curriculum and Instruction  
(51.881 is not a required course for students specializing in Reading.)

\*Students who have completed 51.801 may be excused from 51.880 or 51.881 with the approval of the adviser.

Specializations

Science-Mathematics

51.837 Curriculum Problems in Science and Mathematics

51.838 Seminar in Science and Mathematics Teaching

51.839 Implementing Change in Science and Mathematics Education  
Electives (four to be approved by adviser)

or

Social Studies

51.851 Seminar in Current Issues in the Social Studies

51.853 History and the Social Sciences in the School Curriculum

51.854 Social Science Materials Seminar  
Electives (four to be approved by adviser)

or

English-Language Arts

51.870 Developmental Reading and Writing

51.871 Reading and Language Disabilities I

51.872 Literature and Materials Seminar  
Electives (four to be approved by adviser)

or

Reading

51.870 Developmental Reading and Writing

51.871 Reading and Language Disabilities I

51.872 Literature and Materials Seminar

51.873 Reading Clinic I

51.874 Reading and Language Disabilities II

51.875 Reading Clinic II  
Electives (two to be approved by adviser)

or

General Academic

51.870 Developmental Reading and Writing

51.871 Reading and Language Disabilities I

51.837 Curriculum Problems in Science and Mathematics Education

- 51.838 Seminar in Science and Mathematics Teaching
  - 51.853 History and the Social Sciences in the School Curriculum
  - 51.854 Social Science Materials Seminar
- Elective (one to be approved by adviser)

or

#### Combined Reading Certification

A special program offering the Liberal Arts or non-Education graduate the opportunity to earn the Master of Education degree plus teacher certification (elementary or secondary) and certification as a reading specialist (K-12). This program is for full-time students only and will take a minimum of five full-time quarters to complete. Students will be accepted to begin in the Summer or Fall quarters. (See page 75 for description of the teacher certification part of this program.)

or

#### Other Purposes

A student who wishes to specialize in curriculum and instruction in a field not included in those listed above should make an appointment with an adviser for this program who will help him develop an appropriate course of study by drawing on courses offered throughout the Graduate Schools of the University.

Each candidate's program must be approved by his faculty adviser before he begins his course of study. A student admitted to special student status who feels he may eventually wish to be admitted to degree candidacy must consult with an appropriate faculty adviser before he enrolls in any course.

### Early Childhood Education

In the field of Early Childhood Education two distinct programs are provided at the master's degree level. The programs are in the areas of Administration of Early Childhood Education and Teaching in Early Childhood Education.

#### *Administration of Early Childhood Education*

This program is designed to prepare the student for entry into the field of Administration of Early Childhood Education, to assume such positions as administrator or director of day care centers, nursery schools, kindergartens, and similar organizations. Students completing the program will be expected to display effective administrative behavior related to Early Childhood Education based upon knowledge of children, learning, and the administrative process. A typical program is as follows:

Master of Education Core (required of all candidates)

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development

One additional course from Area III (Social Foundations) or Area IV (Humanistic Foundations)

**Educational Administration Requirements**

- 52.810 Leadership in Education: Part I
- 52.811 Leadership in Education: Part II
- 52.813 Instructional Leadership: Curriculum Development and Supervision
- 52.826 Administration of the Elementary School
- 52.843 Administrative Internship
- 52.828 Administration of Early Childhood Education
- 53.811 Family and Parent Counseling  
or
- 56.835 Socio- and Psychodynamics of Family Life

**Electives**

Two courses chosen in consultation with an adviser

*Teaching in Early Childhood Education*

This program is designed to prepare certified elementary teachers for an instructional or related role in the field of Early Childhood Education such as teacher, coordinator, or supervisor in day care centers, nursery schools, kindergartens, and similar organizations. Students completing the program will be expected to display effective instructional behavior related to Early Childhood Education based upon knowledge of children, teaching and learning. A typical program is as follows:

**Master of Education Core (required of all candidates)**

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- One additional course from Area III (Social Foundations) or Area IV (Humanistic Foundations)

**Early Childhood Program Requirements**

- 51.880 Evolution and Revolution in the School Curriculum
- 51.881 Dynamics of Curriculum Design
- 56.848 Early Childhood Learning Problems—Identification and Program Development
- 93.801 Seminar in Early Childhood Education Theory and Practice
- 93.802 Practicum in Early Childhood Education I
- 93.803 Practicum in Early Childhood Education II
- 53.811 Family and Parent Counseling  
or
- 56.835 Socio- and Psychodynamics of Family Life

**Elective**

One course chosen in consultation with an adviser

For course descriptions see appropriate departmental offerings as well as inter-departmental courses.

**Educational Administration**

In the field of educational administration, three distinct programs are provided at the master's degree level. These programs are in the areas of

elementary and secondary school administration, instructional technology, and occupational education.

### *Elementary and Secondary Administration*

This program is designed to prepare the student for initial entry into the field of educational administration, preparing him for such beginning positions as assistant principal, principal of a small school, department chairman, special program director, or beginning administrator in allied fields, as well as to serve as a foundation for further graduate study. A typical program is as follows:

Master of Education Core (required of all candidates)

Three courses as defined on page 47.

Educational Administration Requirements

52.810 Leadership in Education: Part I

52.811 Leadership in Education: Part II

Departmental Program of Study

52.813 Instructional Leadership: Curriculum Development and Supervision

52.805 Simulated Problems: Secondary School Administration and/or

52.814 Simulated Problems: Elementary School Administration

52.806 Directed Field Experiences in the Administration of the Elementary School

52.807 Directed Field Experiences in the Administration of the Secondary School

52.808 Seminar in Educational Administration

52.826 Administration of the Elementary School and/or

52.827 Administration of the Secondary School

Electives (to be approved by adviser)

Upon completion of the above program, a comprehensive examination is given to each student.

### *Instructional Technology*

In recent years considerable growth and expansion has taken place in the area of technology for instructional purposes. With this thought in mind, the master's degree in this field has been created. It is aimed at formally preparing students to serve effectively as directors of such programs in schools, colleges, government, and industrial settings. This program does not automatically lead to certification as an Audiovisual Media Specialist; those seeking such certification should consult their program adviser.

A typical program:

Master of Education Core (required of all candidates)

Three courses as defined on page 47.

Educational Administration Required Courses (3)

52.810 Leadership in Education: Part I

52.811 Leadership in Education: Part II

52.813 Instructional Leadership: Curriculum Development and Supervision

Instructional Technology Required Courses (5)

52.822 Foundations of Instructional Communications and Technology

52.823 Principles of Instructional Systems Development

52.817 Design, Production, and Utilization of Instructional Materials.

52.818 Developing Curriculum Learning Packages

52.821 Administration of Instructional Media Programs

Upon completion of the above program, a comprehensive examination is given to each student.

*Occupational Education*

This program of study is designed to equip prospective administrators and supervisors of occupational and career education with understandings, skills, and technical competencies which will enable them to assume and perform leadership functions in such positions as coordinators, supervisors, or district-wide directors in elementary schools, regular or comprehensive secondary schools, specialized vocational schools, community colleges, or at the state level. Satisfactory completion of an oral conference and a written comprehensive examination is also a requirement of this program.

Master of Education Core (required of all candidates)

Three courses as outlined on page 47.

Educational Administration Requirements (4)

52.810 Leadership in Education Part I

52.811 Leadership in Education Part II

52.813 Instructional Leadership: Curriculum Development and Supervision

52.826 Administration of the Elementary School  
or

52.827 Administration of the Secondary School

Departmental Program of Studies in Occupational Education (5)

52.806 Directed Field Experiences in the Administration of the Elementary School

52.807 Directed Field Experiences in the Administration of the Secondary School

52.815 Simulated Problems: Administration of Occupational Education

52.816 Seminar in Career Education

52.843 Internship—other appropriate occupational electives from the Graduate School of Education.



## Educational Research

This program is designed to train educational researchers who will have: 1) an understanding of the nature and characteristics of research as it is carried on in educational research agencies; 2) a basic knowledge of research methodology and related theory that will enable them to assist at all stages of educational research; and 3) the technical skill to carry out independently the operational aspect of educational research.

The objectives stated above and the related competencies are achieved through an integrated program of study. This program may be taken on a full- or part-time basis, and study may begin in any quarter. A full-time student will normally complete degree requirements in one academic or calendar year (three or four quarters). The culminating component of the program is the planning, executing, and writing up of research for a thesis, intended as a small-scale but original investigation into a significant educational problem. The thesis may be presented in one of several formats selected jointly by the student and the adviser.

All candidates will be required to complete the following program:

Master of Education Core (required of all candidates)

50.815 Research Design in Education (Area I)

Two courses from the remaining areas as described on page 47.

Educational Research Requirements

50.841 Introduction to Educational Statistics

50.842 Intermediate Educational Statistics

50.817 Advanced Research Design in Education

50.847 Introduction to Computer Programming: FORTRAN IV

50.891 Thesis (equivalent to two courses)

or

50.845-846 Independent Research Seminars I & II

Electives (three)

## Human Development

The overall objective of this program is to provide opportunities for practicing and prospective educators to expand and deepen their knowledge and understanding of human development in its psychological and social aspects. Completion of the program does not lead to state certification, and a teaching certificate is not required for admission to the program. However, the program can provide a useful background for persons teaching, or planning to teach, psychology and behavioral science in secondary and elementary schools. It can also serve as introductory preparation for students who aspire to later doctoral study in the field of human development. Full-time students will take a maximum of four courses per term and will complete the program in a minimum of three quarters. Part-time students will take a maximum of two courses per term and will complete the program in a minimum of six quarters.

Candidates may begin study in any quarter and will be required to complete the following program:

Master of Education Core (required of all candidates)

50.815 Research Design in Education

Two additional courses, one from Area III (Social Foundations) and one from Area IV (Humanistic Foundations).

**Human Development Requirements**

50.806 Psychology of Learning

or

50.811 Psychology of Thinking

50.810 Psychology of Personality

or

50.805 Personality and Social Structure (if not taken in Ed.M. Core, above)

50.808 Seminar in Child Development

50.809 Seminar in Adolescent Development

50.819 Theories of Developmental Psychology

**Electives (choice of courses or thesis):**

Courses: four courses, chosen in consultation with an adviser, from those offered in the Graduate School of Education and other departments in the University

Thesis: 50.817 Advanced Research Design in Education

50.842 Intermediate Educational Statistics

50.891 Thesis (equivalent to two courses)

**Rehabilitation Administration and Special Education**

*Rehabilitation Administration*

This program is designed to prepare students for positions of administrative leadership and research in a wide range of rehabilitation and health care service agencies.

Students majoring in Rehabilitation Administration should anticipate taking 15 credit courses for the degree under either of the following options:

Plan A: For students with limited rehabilitation or administration experience.

The program will be conducted on a cooperative education basis. This means that the student will alternate periods of academic course work with paid practical experience in the field over a 21-month period.

Plan B: For students with considerable rehabilitation or administration experience.

The program takes one calendar year from September through August and includes four academic quarters. During this time the student also completes 500 hours of practical experience in the field. Under Plan B there are a limited number of federal stipends available which are issued on a competitive basis.

Plan C: For students with limited rehabilitation or administration experience who wish an alternative plan to cooperative education.

The program will take a minimum of two calendar years. During that time the student will elect his academic course work, 500 hours of practical field work experience, and a full-time internship experience.

#### Recommended Core Courses

- 50.805 Personality and Social Structure
- 50.807 Abnormal Psychology

#### Department Requirements

- 56.950 Introduction to Rehabilitation
- 56.951 Principles of Medical Rehabilitation
- 56.952 Rehabilitation and Social Services
- 56.953 Organization and Administrative Theory
- 56.961 Rehabilitation Administration I
- 56.963 Rehabilitation Administration II
- 56.832 Group Dynamics
- 56.960 Practicum in Rehabilitation Administration
- 56.956 Community Planning in Rehabilitation

#### Electives chosen from

- 56.957 Federal-State Relations in Rehabilitation
- 56.958 Social Welfare and Rehabilitation
- 56.959 Rehabilitation Research
- 56.962 Administration of a Sheltered Workshop
- 56.964 Rehabilitation and the Law
- 56.965 Occupational Placement
- 52.865 Systems Theory in Education
- 53.815 Rehabilitation Counseling Strategies

#### *Interrelated Programs in Special Education*

Interrelated programs in Special Education offer options to prepare for work with individuals having mild to moderate special needs (emotional disturbance, learning disabilities, mental retardation) or those having severe handicaps in one or more of the above areas. In addition, a concentration in preschool handicapped is available. For those planning to work outside the classroom with schools and/or public or private agencies, there is the program of Special Education Community Personnel (SECP).

In all but the SECP program, eligibility for certification at the elementary or secondary level is the prerequisite for a student to begin concentrating on the special education sequence. Students lacking the above may earn certification through satisfactory completion of prescribed courses in elementary or secondary education at Northeastern. Applicants certified at the secondary level may need additional preparation in areas of reading, mathematics, and methods and materials, at the elementary level, to obtain additional background for work with individuals with special needs.

Degree candidates must demonstrate competency in child psychology, abnormal psychology, and introductory statistics through previous course work or they will be required to complete such course work before graduating. The statistics course may be fulfilled by satisfactory completion of the programmed learning course in statistics given at the University.

An option leading to certification in a single area, providing the student enters the program with elementary or secondary teaching certification, or completion of the SECP program, will normally require four to five quarters of full-time graduate study, preferably beginning in the Summer Quarter. A student who needs to obtain the above certification should expect to spend additional time completing the program.

Field Work and Student Teaching or Practicum placements are an integral part of the Master's Degree program. All students are required to do two quarters of Field Work and one quarter of Student Teaching or Practicum. Educational settings utilized for field work include public and private schools, day and residential programs, and hospital-based educational facilities.

A sequenced program will be developed in consultation with the major adviser based upon the student's background, experience, and interests. It will include basic requirements of the graduate school, the Division, and the State Department of Teacher Certification, where appropriate. Massachusetts' State Department of Education is currently granting Letters of Approval until final certification requirements are established. Electives will be drawn from other programs as warranted.

Completion of all programs in special education is contingent upon the candidate's demonstration of competency in specified fields of knowledge and skills as measured by academic success and satisfactory completion of Field Work and Student Teaching or Practicum. A comprehensive examination will be taken during the quarter in which the student completes nine courses related to the Special Education degree, other than elementary or secondary teaching certification courses.

Students should apply for admission for either the summer or fall quarters. All admissions materials must be complete by April 15 for consideration for either of these two quarters.

### *Financial Aid — Traineeships*

A limited number of traineeships through Federal grants is anticipated for 1976-1977. The student in need of financial help should discuss the matter during the interview with the Division faculty member. The Department has also attempted to develop paid internships in a variety of settings in order to offer students other opportunities for professional development as well as a means of financial assistance. Students selected for an internship will need to plan for a program extending over approximately two years. (Refer also to Financial Aid, page 30.)

## Core Curriculum Requirements

In addition to the Foundations of Education core requirements described on page 47 and the prerequisites described above, the programs in the Division of Special Education have the following common core of required courses:

- 55.806 Language Disturbances in Children
- 56.807 Learning Disabilities
- 56.840 Psychology of Mental Retardation and other Handicapping Conditions
- 56.846-56.847 Special Education Methods and Materials Related to Measurement and Evaluation
- 56.880-56.881 Etiology and Development of Deviations in Special Needs Individuals
- Field Work and Seminar
- Student Teaching and Seminar or Practicum and Seminar

Any core curriculum requirement may be waived if, in the opinion of the adviser, the student has had an equivalent course.

Field Work and Student Teaching or Practicum are specific to the student's major interest. With the written approval of the student's adviser, a student who is approved, certified, or able to be approved in an area of Special Needs, will be required to do Field Work but may not be required to do Student Teaching. The program for each student is designed in relation to his educational and experiential background, his professional goals, and the limitations (such as approval and certification) implied by such goals.

## Teacher Preparation Options

### *Generic Special Educator*

This program option develops competencies (as delineated in Mass. Regulations for Interim Approval) as resource room and consulting teachers dealing with mildly involved special needs children.

#### Recommended Core Courses

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- 50.805 Personality and Social Structure

Department Core Curriculum Requirements  
see page 69.

#### Required Courses for Generic Special Educator

- 56.801 Alternatives for Providing Services for Special Needs Children
- 56.831 Teaching the Emotionally Disturbed

Further electives may be chosen in consultation with the student's academic adviser.

Field Work and Student Teaching assignments will concentrate on mild disabilities in resource room and diagnostic-prescriptive settings.

*Emotional Disturbance — Learning Disabilities*

This area of specialization prepares students to work with mildly to moderately handicapped pupils in a self-contained class or to work as a resource teacher where classes have been integrated.

Recommended Core Courses

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- or
- 50.807 Abnormal Psychology
- 50.805 Personality and Social Structure

Department Core Curriculum Requirements

see page 69.

Required Courses for Emotional Disturbance-Learning Disabilities

- 56.831 Teaching the Emotionally Disturbed

Further electives may be chosen in consultation with the student's academic adviser.

Field Work and Student Teaching assignments will concentrate on various educational and residential settings.

*Mental Retardation — Learning Disabilities*

This area of specialization prepares students to work with mildly to moderately handicapped pupils in a self-contained class or as a resource teacher in a school where classes have been integrated.

Recommended Core Courses

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- 50.805 Personality and Social Structure

Department Core Curriculum Requirements

see page 69.

Required Courses for Mental Retardation-Learning Disabilities

- 56.841 Development and Implementation of Programs for the Moderately Handicapped

Further electives may be chosen in consultation with the student's academic adviser.

Field Work and Student Teaching assignments will concentrate on mild to moderate disabilities in resource room and self-contained classrooms.

### *Severely Handicapped*

Students will be prepared to function as classroom teachers in a variety of settings. Classes may be situated in private or public schools or institutions. It is recognized that the functions of the student will vary greatly depending upon the classroom setting and the requirements of children in any given classroom situation. With this in mind, students will be prepared in certain core areas and then given more specialized training in working with the severely-handicapped. The courses and practicum experience required are designed to meet with standards developed by the Department of Education of the Commonwealth of Massachusetts and similar requirements throughout the country.

#### Required Core Courses

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- 50.805 Personality and Social Structure

#### Department Core Curriculum Requirements

see page 69.

#### Multiply-Handicapped Program

- 56.835 Socio- and Psychodynamics of Family Life
- 56.838 Development and Implementation of Programs for the Severely Handicapped
- 56.839 Severely Handicapped

#### Electives are chosen from

- 56.847 Seminar in Mental Retardation
- 56.848 Early Childhood Learning Problems — Identification and Program Development
- 55.803 Cerebral Palsy
- 55.804 Aphasia
- 55.816 Test Procedures in Speech and Language Pathology
- 55.861 Neuropathology
- 62.842 Physical Education for Students with Special Needs
- 62.860 Early Childhood Motor Patterns
- 62.864 Perceptual Motor Development
- 62.884 Movement and the Learning Process

### *Early Childhood Handicapped*

Teachers who complete this program may function in a variety of roles: (1) teacher in a self-contained handicapped early childhood classroom; (2) teacher of an integrated program; and (3) consultant to other teachers of young children.

**Prerequisite**

Certificate or eligibility for certification in Massachusetts to teach at the elementary level. (This may be waived if newly developed certification procedures do not require such certification.)

Prior training, preferably with experience in "regular" early childhood education. Students without this preparation may be admitted but will be required to take additional appropriate courses.

**Required Core Courses**

- 50.815 Research Design in Education
- 50.808 Seminar in Child Development
- 50.805 Personality and Social Structure

**Departmental Core Curriculum Requirements**  
see page 69.

**Courses for Preschool Handicapped Teacher Program**

- 56.835 Socio- and Psychodynamics of Family Life
- 56.848 Early Childhood Learning Problems — Identification and Program Development
- 53.804 Counseling Theory and Practice

*Special Education Community Personnel*  
(A Noncertification Program)

Northeastern University, Department of Rehabilitation and Special Education, in response to identified needs and national trends, offers a program for individuals with broad interests and abilities to prepare them to function as advocates for handicapped children and youth and to act as liaison between community agencies and the school.

Implied in such a program is the possession or acquisition of knowledge of social problems, teaching, community and school organization, child development, problems of multiple handicaps, and facilities for care, treatment, and remediation. Implied also are skills in working with the handicapped, with peers in numerous professions, and with techniques of survey research. Integrated course and field work experiences will be designed to complement each applicant's background of education and experience. Approximately four to five quarters are estimated for demonstration of competence in the specified areas.

**Recommended Core Courses**

- 50.810 Psychology of Personality
- 50.820 Seminar in Contemporary Issues in American Education

**Department Requirements**

- 56.880-881 Etiology and Development of Deviations in Special Needs Individuals
- 56.840 Psychology of Mental Retardation and Other Handicapping Conditions
- 56.807 Learning Disabilities
- 56.853 Field work and Seminar
- 56.854 Practicum



Electives chosen from

- 56.952 Rehabilitation and Social Service
- 56.956 Community Planning in Rehabilitation
- 56.835 Socio- and Psychodynamics of Family Life
- 56.839 Severely Handicapped
- 56.845 Rehabilitation and the Special Education Teacher
- 51.920 Methods and Materials in Adult Literacy Education

Other courses in consultation with adviser.

## **Speech Pathology and Audiology**

The program leading to the degree of Master of Education in either Speech Pathology or Audiology is designed to qualify candidates for membership in and certification by the American Speech and Hearing Association. Graduates of the program are also qualified for further graduate study and for employment as speech pathologists or audiologists in clinics, hospitals, public schools, and rehabilitation centers.

This program assumes that students have completed an undergraduate program in speech and hearing. Such students, who have had the necessary academic preparation and a minimum of 150 clock hours of clinical practice, may expect to devote a minimum of five or six academic quarters to complete the practicum requirement. Students who do not have the proper academic and clinical background on the undergraduate level may expect to devote a minimum of seven or eight academic quarters to complete the practicum requirements. Applicants should specify a major in either Speech Pathology or Audiology.

This program is conducted with the cooperation of a large number of community agencies.

### *Speech Pathology*

Each student's program is individually designed with the assistance of a faculty adviser to assure that course work is distributed in all major professional areas including: diagnostics, articulation, language, fluency, voice, and audiology. The student is also advised about how his program prepares him to meet certification requirements established by the American Speech and Hearing Association.

Master of Education Core (required of all candidates)

Three courses as defined on page 47.

- 55.813 Advanced Clinical Practice

### **Speech Pathology Courses**

A minimum of nine courses selected from the following or appropriate electives:

- 55.803 Cerebral Palsy
- \*55.804 Aphasia
- 55.805 Disorders of Voice

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\*Required or an equivalent graduate level course.

- \*55.806 Language Disturbances in Children
  - 55.811 Clinical Management in Stuttering
  - \*55.812 Differential Diagnosis in Speech and Language Pathology
  - \*55.816 Test Procedures in Speech and Language Pathology
  - 55.817 Advanced Anatomy, Neurology and Physiology of Speech-Hearing Mechanism
  - 55.822 Seminar in Oro-facial Anomalies
  - 55.823 Psycho-social Aspects of Communication Disorders
  - 55.861 Neuropathology
  - 55.824 Seminar in Speech Pathology
  - 55.860 Aphasia Rehabilitation
  - 55.863 Advanced Study of Articulation Disorders
  - 55.891 Thesis (optional)
  - 55.899 Directed Study (optional)
- Satisfactory completion of a comprehensive examination is a requirement of this program.

### *Audiology*

Each student's program is individually designed with the assistance of a faculty adviser to assure that course work is distributed among evaluation, diagnosis, and aural rehabilitation. The student is also advised about how this program prepares him to meet certification requirements established by the American Speech and Hearing Association.

Master of Education Core (required of all candidates)

Three courses defined on page 47.

55.813 Advanced Clinical Practice

#### Audiology Courses

A minimum of nine courses selected from the following or appropriate electives:

- 55.814 Clinical Audiometry I
- 55.815 Clinical Audiology
- \*55.817 Advanced Anatomy, Neurology, and Physiology of Speech-Hearing Mechanism
- \*55.818 Pathologies of the Ear
- 55.819 Clinical Audiometry II
- 55.820 Physiological Acoustics
- 55.821 Seminar in Audiology
- 55.823 Psycho-social Aspects of Communication Disorders
- 55.862 Psycho-acoustics
- 55.825 Teaching Speech to Deaf Children
- 55.826 Teaching Language and Reading to Deaf Children
- 55.828 Aural Rehabilitation
- 55.891 Thesis (optional)
- 55.899 Directed Study (optional)

Satisfactory completion of a comprehensive examination is a requirement of this program.

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\*Required or an equivalent graduate level course.

### *Teaching the Deaf*

The following curriculum in the preparation of teachers of the deaf is offered in affiliation with the Boston School for the Deaf. Candidates lacking prerequisite courses will be required to complete them prior to the following program.

Master of Education Core (required of all candidates)

Three courses as defined on page 47.

Teaching the Deaf Requirements

- 55.814 Clinical Audiometry I
- 55.815 Clinical Audiology
- 55.816 Test Procedures in Speech and Language Pathology
- 55.825 Teaching Speech to the Deaf
- 55.826 Teaching Language and Reading to the Deaf
- 55.827 Methods and Materials in Deaf Education
- 55.828 Aural Rehabilitation
- 55.852 Practicum: Teaching the Deaf (8 quarter hours)

### **NONDEGREE PROGRAM FOR CERTIFICATION OF ELEMENTARY AND SECONDARY TEACHERS**

This program is designed to qualify college graduates for certification as elementary or secondary teachers in the Commonwealth. Students who are interested in qualifying to teach in other states should obtain a copy of that state's certification requirements and bring it to the initial interview with their advisers.

This program is open to individuals who meet the general admission requirements for the Master of Education degree. In addition, students whose backgrounds may not include an approved course in such areas as human development or learning must take such a course either before they enter the program or before student teaching. Furthermore, candidates for secondary certification must have completed, before admission, 36 quarter hours of courses in the field in which they are preparing to teach, with a QPA for all courses taken in that field of at least 2.000. No special students will be admitted to these courses; no transfer of courses or credit will be allowed.

This is a part-time, integrated, one-year program which begins in the Fall Quarter and continues through the following Winter and Spring Quarters. It requires that a student attend classes two nights a week during the Fall and Winter Quarters and spend full-time (days) as a student teacher in a school during the Spring Quarter.

The program consists of a sequence of inter-related activities led by a team of teaching specialists in elementary and secondary education and in the fields of mathematics, English, reading, science, and history and the social sciences.

Course Sequence

(The courses must be taken in the order listed):

Fall Quarter

51.800 Principles of Teaching

51.863 Methods and Materials for Teaching Children I  
or

51.865 Methods and Materials for Teaching Adolescents and Adults I

Winter Quarter

51.801 Curricula of American Schools

51.864 Methods and Materials for Teaching Children II  
or

51.866 Methods and Materials for Teaching Adolescents and  
Adults II

Spring Quarter

51.805 Student Teaching with Related Seminar

Applications for Student Teaching must be received by the Director of  
Field Placement no later than October 15.

This program does not lead to any degree. However, applicants who are able to be full-time graduate students may apply for simultaneous admission to most programs requiring certification in the Graduate School of Education. Such students may take one or two courses in the degree program along with the certification courses (except during the Student Teaching quarter when no courses may be taken), but must complete certification requirements during the first year of study. Twelve quarter hours (3 courses) taken in the nondegree program may be used as electives in a master's program subject to approval of the adviser. Students who cannot devote full-time to graduate study may apply to master's degree programs after successful completion of the certification program.

### **CERTIFICATE OF ADVANCED GRADUATE STUDY**

The Certificate of Advanced Graduate Study is available to applicants who have demonstrated a strong background in the special field of study at the master's level and who meet the specific requirements of the Graduate School of Education and the appropriate department. CAGS programs are offered in the areas of:

Counselor Education

Pupil Personnel Services Administration

School Psychology

Counseling

School

College

Community Mental Health

Rehabilitation

Educational Administration

Cooperative Education

Educational Administration

Higher Education

Instructional Technology

Rehabilitation and Special Education Administration

All students must complete one of the programs as outlined in the following pages. In most cases, the sequence is designed to be very flexible. Any variations or changes must have the prior recommendation of the major adviser and approval of the Director of the Graduate School of Education.

### **Counselor Education**

The CAGS represents a second year of preparation beyond the master's degree for the counseling and human services field. This is not a predoc-toral program but a terminal professional degree program. There are several major options in the Counselor Education Department: Pupil Personnel Services Administration, School Psychology, and Counseling (School, College, Community Mental Health, Rehabilitation). Students with master's degree work in rehabilitation counseling who wish to emphasize administrative preparation at the CAGS level should enter the Rehabilitation Administration program.

Each of these counselor education program concentrations presumes master's level preparation in counseling the equivalent of that offered at the University. Students whose master's program in Counselor Education lacked a practicum will be required to take 53.805-53.806 in addition to the minimum course requirements for the CAGS. Students with master's degrees in fields other than counseling will, if otherwise admissible, be required to make up a minimum of five courses from the master's program. These students will need a minimum of two years to complete the requirements for the CAGS.

In addition to the course requirements, students must pass a comprehensive examination (written and/or oral) before the certificate will be awarded.

After filing all application materials required by the Graduate School, applicants will be contacted by the Department to arrange for admissions interviews. Since there is a limited number of spaces in the CAGS program, early application is urged.

#### *Pupil Personnel Services Administration*

Students who have prepared themselves for school counseling positions and who are interested in leadership positions in guidance and pupil personnel services should choose this option. The program provides for further work in counseling, but emphasizes administrative and organizational preparation for the effective delivery of personnel services to students. Field work placements will provide for the development of skills and knowledge in planning, supervision, and delivery of services within the context of the total educational program of the school system.

A typical program is as follows:

- 53.840-53.841 Advanced Field Work
- 53.834 Advanced Theories of Behavior Change
- 53.833 Seminar in Counseling Supervision and In-Service Education
- 53.807 Administration of Guidance Services
- 52.810 Leadership I
- 52.811 Leadership II
- 52.831 Innovation and Change in American Public Schools
- 52.832 The Process of Administration
- Three Electives

### *Counseling*

Students whose primary interest is the delivery of individual and group counseling services in a variety of settings, including, but not limited to, schools, college counseling centers, rehabilitation, and mental health centers, should choose this option. This program provides for a more "therapeutic" orientation but is not as focused on a particular setting or category of settings. Field placements will provide for the development of the student's individual and group counseling skills and will be varied according to individual need and interest. Mental health settings will tend to predominate in the field assignments.

A typical program for School, College, and Community Mental Health Counseling is as follows:

- 53.840-53.841 Advanced Field Work
- 53.834 Advanced Theories of Behavior Change
- 53.816 Psychological Counseling Strategies
- 53.818 Case Studies in Marriage and Family Counseling
- 53.831 Advanced Group Counseling
- 53.835 Psychodiagnostic Measures
- 50.819 Theories of Developmental Psychology
- 50.807 Abnormal Psychology
- Three Electives

A typical program for Rehabilitation Counseling is as follows:

- 53.840-53.841 Advanced Field Work
- 53.834 Advanced Theories of Behavior Change
- 53.831 Advanced Group Counseling
- 53.818 Case Studies in Marriage and Family Counseling
- 56.980 Psychological Problems of Disability
- 56.982 Essentials of Case Management and Supervision
- 56.983 Rehabilitation of Alcoholic and Drug Dependent
- 56.984 Rehabilitation of the Penal Offender
- Three Electives

### *School Psychology*

The course offerings and field experiences in this program are designed to prepare students as school psychologists. In accordance with Massachu-

sets certification requirements, the goal is to develop professional competencies necessary for providing direct, specific, and practical assistance to students, classroom teachers, parents, and other school personnel in promoting an optimal psycho-educational experience. In addition to the general Certificate of Advanced Graduate Study admission requirements, applicants for the School Psychology program must have at least 24 semester hours (32 quarter hours) of undergraduate work in psychology and a master's degree in a psychology-related field.

This specialization is sponsored jointly by the Graduate School of Education and the Department of Psychology in the College of Liberal Arts. Applicants for this program will be interviewed by both the Department of Counselor Education and the Department of Psychology. The admitted student will be assigned an adviser from one of these two departments who will plan the student's program.

Courses to meet the degree and certification requirements will be selected from the Graduate School of Education and the Department of Psychology to reflect the following areas of study: learning theory, counseling strategies and interviewing, psychodiagnosis, remediation, special education, curriculum, organizational development, school structure, psychopathology, human development.

Two years of field experience as a school psychology trainee under the supervision of a certified school psychologist are required.

A typical program is as follows:

- 53.843-53.844 School Psychology Field Work
- 51.870 Developmental Reading and Writing or
- 51.871 Reading and Language Disabilities I
- 56.840 Psychology of Mental Retardation and other Handicapping Conditions
- 19.822 and 19.823 Psychopathology I and II
- 53.835 Psychodiagnostic Measures
- 53.821 Psychoeducational Prescriptions
- 53.820 Seminar in School Psychology
- Two courses in Personality and Development

\*Elective(s)

\*The number and selection of electives will depend upon the student's master's degree program content and state certification guidelines.

## **Educational Administration**

Beyond the master's degree level, four advanced administrative training programs at the Certificate of Advanced Graduate Study (CAGS) level are offered. These programs are in the fields of cooperative education, educational administration, higher education, and instructional technology.

### *Cooperative Education*

A program of study at the master's level in the area of cooperative education is located in the Counselor Education Department. The program

offered here is an advanced one aimed at the preparation of administrators of cooperative education programs in a variety of settings: the public schools, vocational-technical schools, and junior colleges, as well as at other institutions of higher learning.

A typical program is as follows:

**Required Core**

- 52.830 Current Issues in Educational Administration
- 52.831 Innovation and Change in American Public Schools
- 52.832 The Process of Administration
- 51.900 Cooperative Education in America
- 52.824 The Administration of Cooperative Education

**Electives**

A minimum of seven to be selected in consultation with the student's adviser. These courses will be drawn from the appropriate areas of administration, counselor education, or other related offerings depending upon the student's career goals in settings such as: colleges, junior colleges, public schools, and other educational agencies.

Upon completion of this program, a comprehensive examination is given to each student.

### *Educational Administration*

The Certificate of Advanced Graduate Study (CAGS) program in Educational Administration is designed to provide the student with a closer examination of a particular administrative or supervisory position. Extending beyond the generic master's degree program, major emphasis is given to role specialization and the particular skills that should be acquired by prospective and practicing school administrators. Completion of this program should develop further the leadership capabilities essential to the student's area of specialization such as: the principalship of a large school; the assistant superintendency; the superintendency of a small district or supervisory union; directorship of federal, system-wide or state education department programs.

*A minimum of 12 courses beyond the master's degree is required for completion of the program as well as satisfactory completion of a comprehensive examination.*

**Core Courses (required)**

- 52.830 Current Issues in Educational Administration
- 52.831 Innovation and Change in American Public Schools
- 52.832 The Process of Administration

**Electives**

- 52.834 Educational Finance
- 52.835 School Business Management
- 52.836 Personnel Administration
- 52.837 School-Community Relations
- 52.838 School Plant Planning, Operation, and Maintenance



- 52.840 Problems in School Administration: A Simulated Experience  
— The Superintendency
- 52.842 Problems in School Administration: A Simulated Experience  
— Assistant Superintendent for Instructional Services
- 52.899 Direct Study
- 52.843 Administrative Internship
- 52.844 School Law
- 52.865 Systems Theory in Education
- 52.866 Politics and Educational Decision Making
- Other electives approved by adviser

### *Higher Education*

This program of study is directed toward the training of college administrators. Emphasis is placed on the development of attitudes, understandings, and skills necessary to prepare the potential administrator and to give this development the necessary philosophic base on which the administrator can build an effective career.

A typical program is as follows:

#### Required Core

- 52.830 Current Issues in Educational Administration
- 52.831 Innovation and Change in American Public Schools
- 52.832 The Process of Administration

#### Electives

A minimum of nine to be selected in consultation with the student's adviser. These courses will be drawn from appropriate areas of administration, counselor education, and other related offerings depending upon the particular higher education specialization of the student.

Upon completion of this program, a comprehensive examination is given to each student.

### *Instructional Technology*

The Certificate of Advanced Graduate Study (CAGS) program in Instructional Technology is designed to provide the student with advanced administrative and instructional technology skills. Four areas of contact are integrated into this advanced program. A broad exposure is presented in the field of educational administration through the core courses. Instructional technology electives provide the student with advanced techniques of using modern technology for instructional purposes. By means of educational administration electives, reasonable depth is provided in such areas as finance, physical facilities, and community relations. And finally, by means of additional electives throughout the University, further contacts and expertise may be attained.

Upon completion of this advanced program, the student is prepared to assume top leadership in the field of instructional technology in central office positions of a public school system as well as directorship of such

specialized programs in industry, government, institutions of higher learning, and privately operated instructional programs in urban settings.

A typical program is as follows:

Educational Administration Core Courses (3)

52.830 Current Issues in Educational Administration

52.831 Innovation and Change in American Public Schools

52.832 The Process of Administration

Instructional Technology Electives (minimum of 4 as approved by the adviser)

Educational Administration Electives (minimum of 4 as approved by the adviser)

Electives (optional number)

Upon completion of the above program, a comprehensive examination is given to each student.

## **Rehabilitation and Special Education**

### *Rehabilitation Administration*

The CAGS Program in Rehabilitation Administration is offered for students who already possess a master's degree in rehabilitation administration or its equivalent. It is intended to enable a student to develop advanced skills in the areas of program planning, decision making, communication and research design in administration. In addition, the educational experience will be substantively focused in areas of service to fields of corrections, alcohol and drug addiction, geriatrics, and social welfare.

A minimum of twelve (12) courses beyond the master's degree is required for completion of the program. In addition to course requirements and demonstration of competencies in both academic and practicum areas, students must pass a written and/or oral comprehensive examination before the certificate will be awarded.

Departmental Core Courses (Required)

56.959 Rehabilitation Research

56.980 Psychological Problems of Disability

56.981 Administrative Problems in Rehabilitation

56.986 Critical Issues in Rehabilitation Administration

Electives

56.982 Essentials of Case Management and Supervision

56.983 Rehabilitation of the Alcoholic and Drug Dependent

56.984 Rehabilitation of the Penal Offender

56.985 Rehabilitation of the Geriatric Client

52.832 The Process of Administration

52.836 Personnel Administration

52.843 Administrative Internship

52.899 Directed Study

56.832 Group Dynamics

*Special Education Administration*

An interrelated program at the CAGS level is designed to prepare administrators of Special Education programs in public schools and in local and state institutions and agencies.

Students entering the CAGS program in Special Education Administration must have a master's degree, equivalent to that offered at the University, in one or more areas of special education and at least three years of classroom experience. Some students may have to take prerequisite courses to satisfy deficiencies.

**Core Requirements**

- 52.830 Current Issues in Educational Administration
- 52.831 Innovation and Change in American Public Schools
- 52.832 The Process of Administration
- 56.953 Organization and Administrative Theory

**Department Requirements**

- 56.952 Rehabilitation and Social Services
- 56.870 Administration and Supervision of Special Education
- 56.839 Severely Handicapped
- 56.956 Community Planning in Rehabilitation
- 52.843 Administrative Internship

**Electives**

- 56.832 Group Dynamics
- 52.813 Instructional Leadership: Curriculum Development and Supervision
- 56.959 Rehabilitation Research
- 52.865 Systems Theory in Education
- 52.835 School Business Management

A minimum of twelve (12) courses beyond the master's degree is required for completion of the program.

In addition to course requirements and demonstration of competencies in both academic and practicum areas, students must pass a written and/or oral comprehensive examination before the certificate will be awarded.

**DOCTOR OF EDUCATION**

The Doctor of Education (Ed.D.) degree program in Leadership: Administration and Supervision is offered jointly by various departments within the College of Education and brings together a functional part of each into a single entity. The area of study, administration and supervision, is appropriate to any candidate seeking a terminal degree in the related fields of school administration, rehabilitation administration, and higher education administration. Each degree candidate is involved in an academic experience that is an individually developed program of courses

and activities. Such study will contribute to an integration of knowledge about the theoretical and pragmatic learnings pertaining to the chosen field of endeavor.

Specific concentrations may be found in elementary and secondary school administration, school central office administration, administration of special education, and pupil personnel administration. In addition to the wide range of school administrative and supervisory specializations, other program concentrations include rehabilitation administration, administration of community, junior and four-year colleges, administration of cooperative education, student personnel administration, and general educational administrative planning and development.

Although each student's program is individually developed, some general requirements apply to all. The program consists of approximately seventy-six quarter hours of study beyond the master's degree. In addition to course requirements, each student is expected to complete three quarters of full-time study in residence. Two of these quarters must be consecutive (one of which may be in the Summer Quarter), the third may occur at any time in the program or may be fulfilled through a fulltime internship. In each student's program, the major field of study must be complemented by two minor areas of study from offerings in the College of Education and other colleges within the University. Each student is expected to complete a doctoral dissertation.

The Doctor of Education degree is awarded to candidates who present evidence of proficiency, high attainment, and research, competence in their area of specialization, and who also demonstrate potential for professional educational leadership.

Following is the general type of program format that will be developed for each student.

## **PROGRAM OF STUDIES**

### *Leading to the Doctor of Education Degree in Leadership: Administration and Supervision*

#### **Courses**

##### **Required Core (required of all students)**

- 52.850 Doctoral Seminar in Leadership: Administration and Supervision I
- 52.851 Doctoral Seminar in Leadership: Administration and Supervision II
- 52.852 Doctoral Seminar in Leadership: Administration and Supervision III

##### **Program Specialization (minimum of 32 quarter hours)**

A planned sequence of courses in the student's specific area of concentration, i.e.,

School Administration  
Rehabilitation Administration  
Higher Education Administration  
Cooperative Education Administration  
Special Education Administration  
Pupil Personnel Administration

Outside Minor Supporting Area (minimum of 12 quarter hours)

A planned sequence of graduate courses from departments within the University, but outside the College of Education.

Inside Minor Supporting Area (minimum of 12 quarter hours).

A planned sequence of graduate courses within the College of Education, but outside the student's main area of concentration.

Dissertation and Dissertation Seminar (required of all students).

In addition to these general program requirements, each student will be expected to complete a qualifying examination, provide evidence of intermediate statistical proficiency, pass final comprehensive and oral examinations. These requirements are described elsewhere in the catalog.

# description of courses

All courses carry four quarter hours of credit unless indicated otherwise. Please see the current schedule for Summer, Fall, Winter, and Spring Quarter listings.

## FOUNDATIONS OF EDUCATION

### **50.801 Educational Anthropology**

Examination of schooling as a particular variety of socialization, with special attention to characteristics of societies that rely heavily on formal instruction, contrasted with less deliberately patterned techniques of child-rearing. Readings will be mainly cross-cultural, ethnographic, and historical. The emphasis of the course varies from quarter to quarter, and will be announced in the registration materials distributed in advance of each quarter. (core course)

### **50.802 Sociology of Education**

The functioning of educational institutions in their social and cultural milieu will be examined from anthropological and sociological perspectives. The school as a social system; influence of the stratification system, youth cultures, and racial antagonisms upon the educational enterprise. (core course)

### **50.803 Child Psychology**

A review of the principles of child development from birth to pre-adolescence. Particular emphasis will be placed on intellectual, social, and emotional development. The theoretical formulations of psychoanalysis, social learning theory, and Piaget will be discussed in the context of relevant research in these areas, as well as their educational implications. (core course)

### **50.804 Adolescent Psychology**

Social, emotional, and intellectual development through the adolescent years. Problems in family relationships and in the adolescent's social environment as well as his adjustment in school. Case history material. (core course)

### **50.805 Personality and Social Structure**

Human behavior from a combined psychodynamic and sociological point of view, with special emphasis on socialization and the relations between the individual and the collectivity. The integration of relevant theories from psychology, sociology, and anthropology. *Suggested Prep. a course in sociology, cultural anthropology, or social psychology.* (core course)

### **50.806 Psychology of Learning**

The basic principles and conditions of acquisition, retention, and transfer of learning. *Suggested Prep. a course in psychology.* (core course)

### **50.807 Abnormal Psychology**

How personality becomes disordered. Problems of neurosis, character disorders,

psychosomatic disorders, and psychoses. Current methods of clinical diagnosis and treatment will be reviewed. (With the approval of the adviser, may serve as a core course for students majoring in Counselor Education, Rehabilitation Administration, Special Education, Speech Pathology and Audiology.)

#### **50.808 Seminar In Child Development**

A seminar course with emphasis on discussion of child development theories with special reference to personality and cognitive development. Critical evaluation of research related to child development theories with particular emphasis on recent trends, new approaches, and relevance to educational theories and practices. *Prep. a course in child psychology or human development.* (core course)

#### **50.809 Seminar In Adolescent Development**

A seminar course with emphasis on discussion of major problem areas facing the adolescent in our society today. Particular emphasis will be given to social and emotional development. Included will be a survey of research in such areas as psychoanalysis, social learning, morality, and delinquency. *Prep. a course in adolescent psychology or human development.* (core course)

#### **50.810 Psychology of Personality**

An examination of theoretical approaches to the study of personality, with emphasis upon theories dealing with dynamic factors in personality development. The role of social and cultural factors, as well as implications as various theories for the therapeutic processes, will be considered. *Suggested Prep. a course in psychology.* (core course)

#### **50.811 Psychology of Thinking**

A consideration of the processes involved in cognitive organization and functioning. Topics will include: language, concept formation, and problem solving. *Suggested Prep. a course in psychology.* (core course)

#### **50.812 History of Education**

An opportunity to explore some of the historical roots of contemporary educational theory and practice, with a focus on selected aspects of educational history from antiquity to the present. Also, an opportunity to utilize knowledge gained for the development of a personal educational position. (core course)

#### **50.814 Nature and Theory of Psychological and Educational Measurement**

An examination of the logic of measurement and the nature of human capacities, aptitudes, and abilities. Characteristics of tests, ratings, questionnaires, and similar instruments are reviewed with emphasis on their reliability, validity, and useability. Item analysis procedures and test standardization are covered.

#### **50.815 Research Design In Education**

An introduction to scientific methods of research in education and related fields. Stress will be placed on critical reading and understanding of research literature, formulating research hypotheses, constructing a research proposal, and carrying out an individual or group project. This course must be included among the first six courses taken by each student. (core course)

A course in statistics, or competence in this field, as demonstrated by successful completion of a statistics proficiency exam, is required prior to taking this offering. A

no-credit, no-charge programmed course in statistics has been arranged for this purpose and is available through the University's Learning Center, 406 Dodge. The regular tuition course, 50.841, is also available. Students choosing the proficiency exam route may also use the services of a special teaching assistant who has been appointed to advise and assist them. The office hours and location of the teaching assistant will vary from quarter to quarter and may be obtained from the Foundations Department Secretary in 306 Cushing.

#### **50.817 Advanced Research Design In Education**

Each student will identify a research problem, review the relevant research literature, design an appropriate methodology, and prepare a written research proposal. *Prep. 50.815 Research Design in Education*

#### **50.818 Comperative Education**

Introduction to education in other nations, and exploration of its relationships with the political, economic, social, and cultural milieu. Selected countries in Western and Eastern Europe, South America, and Africa will be considered. (core course)

#### **50.819 Theories of Developmental Psychology**

The major developmental theories and related research of Havighurst, Erickson, Piaget, and others. *Prep. permission of instructor.*

#### **50.820 Seminar in Contemporary Issues In American Education**

Discussion of selected issues in contemporary American education such as school desegregation, compensatory education, learning problems of the disadvantaged, professionalization of teachers, etc. Review of relevant research and opinions. The topic or topics of the seminar for a particular quarter will be announced in the registration materials distributed in advance of that quarter. (core course)

#### **50.821 Sex Roles In Education**

This course identifies and examines some of the major issues related to sex roles in both the formal and informal educational systems of our society. Topics that will come under special scrutiny include: development of sex role patterns in the home and preschool and through children's books, games, and television programs; life for boys and girls in the elementary and high school classroom; sex bias in counseling and in vocational guidance and training; changes in traditional family roles and occupation hierarchies; assets and liabilities of coeducational and single sex education. The course will also allow students, in small groups, to explore their own sex role attitudes and the strategies they use to socialize young people.

#### **50.822 Topics In the Philosophy of Education**

A study of the basic assumptions underlying statements of educational content, process, and aims. Materials to be subjected to philosophical analysis are selected from educational and philosophic writings according to themes (e.g., authority and freedom, "growth" as an educational objective, the nature of educational relationships). The themes dealt with vary from quarter to quarter, depending on the concerns and interests of students and instructor. Brief lectures, mostly discussion. (core course)

#### **50.841 Introduction to Educational Statistics**

Basic descriptive statistics for measurement and research. Topics include use of



statistical notation, measures of central tendency and variability, probability and sampling techniques, theoretical distributions, linear regression and correlation, and an introduction to statistical inference. (This course, or completion of a statistics proficiency examination, is required for admission to 50.815 Research Design in Education.)

#### **50.842 Intermediate Educational Statistics**

Statistical inference of normal populations and discrete data; estimation; testing of hypotheses; multiple correlation; analysis of variance and covariance; contingency; the chi-square test and other non-parametric tests. Emphasis is given to application in educational research. *Prep. completion of an introductory course in statistics or completion of a proficiency examination in statistics or permission of instructor.*

#### **50.845-846 Independent Research Seminars I and II** (4 quarter hours each)

Focus is on the design, conduct, analysis, and reporting of data from an individual research project. This project may be original or secondary, applied, theoretical, or action research and must be substantially larger in scope than that accommodated by Directed Study. Evaluation will be based on oral and written interim reports in Seminar I and oral and written final reports in Seminar II. This course will serve as an option to the thesis requirement only for students enrolled in the master's degree program in Educational Research.

#### **50.847 Introduction to Computer Programming: FORTRAN IV**

A laboratory course designed to develop facility in the use of a wide range of data processing equipment in educational research. Students will be introduced to the basic principles of computer programming, but emphasis will be placed on the applicability and use of existing statistical programs.

#### **50.850 Communications Theory**

An introduction to communications theory, covering models of the communication process, attitude changes, information, innovation, dissemination and flow, communication modalities, and language processing. (core course)

#### **50.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

#### **50.892 Dissertation Seminar**

This seminar is open only to doctoral candidates who are ready to begin work on their dissertations. Although the dissertation proposal is formulated independently of the seminar, with the doctoral adviser and committee, this seminar will aid in proposal development and provide information on methodology, style, and mechanics of dissertation writing. *Prep. course in research methods in education (50.815 or equiv.) or permission of the instructor.*

#### **50.895 Institute in Foundations of Education**

(See general institute description on page 122.)

#### **50.898 Workshop In Foundations of Education**

(See general workshop description on page 123.)

**50.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

**CURRICULUM AND INSTRUCTION****51.800 Principles of Teaching**

A consideration of the rational bases for effective teaching. Efforts are made to relate learning theory and educational objectives to various strategies and tactics of teaching. The functions of the teacher are examined as components of learner development. *Prep. must be taken concurrently with 51.863 Methods and Materials for Teaching Children I or 51.865 Methods and Materials for Teaching Adolescents and Adults I.* Offered Fall Quarter only. (Open only to students in the Nondegree Certification Program.)

**51.801 Curricula of American Schools**

Methods of organizing material to be learned at the state, district, school, and classroom level to meet the needs and to match the abilities of the students. Attention will be given to innovative practices which are found both within and outside of the public school system. *Prep. 51.800 Principles of Teaching; must be taken concurrently with 51.864 Methods and Materials for Teaching Children II or 51.866 Methods and Materials for Teaching Adolescents and Adults II.* Offered Winter Quarter only. (Open only to students in the Nondegree Certification Program.)

**51.802 Procedures of Evaluation**

Consideration is given to evaluation as a process for the improvement of learning and instruction. The course concerns itself with such topics as how to measure and evaluate affective, psycho-motor, and cognitive dimensions of student growth; test construction; collecting and administering standardized tests; various bases of grading; and methods of reporting student progress.

**51.805 Student Teaching with Related Seminar**

(8 quarter hours)

A University-arranged practicum of observation and teaching in schools offering comprehensive programs within reasonable commuting distance of the University. Participating on a full-time basis, the student is expected to develop planning and communication abilities within his major field. Biweekly seminars at the University provide additional opportunity to analyze theory-practice relationships and to examine generic problems of teaching. *Prep. course in child or adolescent psychology; 51.800 Principles of Teaching; 51.801 Curricula of American Schools; 51.863-864 Methods and Materials for Teaching Children I & II or 51.865-866 Methods and Materials for Teaching Adolescents and Adults I & II.* Generally completed during the Spring Quarter. (Open only to students in the Nondegree Certification Program.)

**51.810 Modern Topics in Elementary School Mathematics**

An introduction to the modern elementary school mathematics curriculum for teachers and students preparing to teach, who are not acquainted with these topics.

**51.811 Mathematics of the Primary Grades**

The concepts of arithmetic and geometry found in modern mathematics courses for grades K-3. *Prep. teaching experience.*

**51.812 Mathematics of the Middle Grades**

The concepts of arithmetic and algebra found in modern mathematics courses for grades 4-6. *Prep. teaching experience.*

**51.813 Informal Geometry for Teachers**

The concepts of geometry found in the modern mathematics curriculum of grades 4-8. *Prep. teaching experience.*

**51.824 The Teaching of Geometry in the High School**

A study of students, teaching methods, and courses in geometry, with re-examination of selected background topics, including two-value logic, methods of proof, postulational systems, and analytical methods.

**51.825 Seminar in Mathematics Education**

Each student is expected to analyze a mathematics learning problem, to investigate relevant research, and to prepare materials embodying his own proposed solution. *Prep. permission of instructor.*

**51.830 Concepts of Earth Science for Elementary Teachers**

Selected topics in the earth sciences considered from a philosophical and/or historical point of view, to illustrate and emphasize man's interrelationship with his ecological environment; with laboratory work. (51.830, 51.831, and 51.832 are not sequential, and may be taken in any order.)

**51.831 Concepts of Biology for Elementary Teachers**

Selected topics in the biological sciences considered from a philosophical and/or historical point of view; a realistic consideration of man's place in his biological world; with laboratory work. (51.830, 51.831, and 51.832 are not sequential, and may be taken in any order.)

**51.832 Concepts of Physical Sciences for Elementary Teachers**

Selected topics in the physical sciences considered from a philosophical and/or historical point of view; the appraising of claims and counter-claims relative to the pollution of man's physical environment; with laboratory work. (51.830, 51.831, and 51.832 are not sequential, and may be taken in any order.)

**51.837 Curriculum Problems in Science and Mathematics Education**

The process of identifying problems and evaluating proposed solutions, taking into consideration the needs of the student population, the dichotomy of theory and applications in course design, and the role of common processes and conceptual schemes in integrating seemingly disparate courses. Traditional and modern programs will be investigated in terms of the problems they were designed to solve, their success or failure in this mission, and the relevance of such programs to present problems. *Prep. teaching experience or certification.*

**51.838 Seminar in Science and Mathematics Teaching**

The analysis and evaluation of a number of types of teaching strategies and learning materials, including laboratory materials and techniques, printed matter of all types, games, kits, multimedia materials, and interactive computer programs. Each student will be expected to undertake an extensive project applying his knowledge of strategies and materials to the achieving of previously identified objectives and ap-

propriate to a given class, group, or individual student. *Prep. teaching experience or certification.*

### **51.839 Implementing Change in Science and Mathematics Education**

The planning, organization, and execution of in-service experiences for teachers, related to all phases of science and mathematics education from subject-matter courses to curriculum planning to materials workshops. *Prep. teaching experience or certification.*

*Recommended: 51.837 Curriculum Problems in Science and Mathematics Education, 51.838 Seminar in Science and Mathematics Teaching, and 51.881 The Dynamics of Curriculum Development.*

### **51.842 The English-Language Arts Curriculum**

The design and function of the English-language arts curriculum; selected current issues as they impinge upon the English-language arts curriculum; the design and function of research in the English-language arts curriculum. Open to certified or experienced teachers; required of all candidates for the Master of Education in Curriculum and Instruction: English, and the Master of Education in Curriculum and Instruction: Language Arts. *Prep. permission of instructor.*

### **51.843 Literature in the English-Language Arts Curriculum**

The historical-social, psychological, personal, archetypal, textual, biographical, and philosophical-moral aspects of literary study and their relation to the chronological, thematic, and generic demands of the literature program; the sources of interest in literature as they relate to the young reader and their implications for the English-language arts curriculum; the inter-relatedness of literature and the other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep. 51.842, The English-Language Arts Curriculum or permission of instructor.*

### **51.844 Writing in the English-Language Arts Curriculum**

The cognitive and affective bases of imaginative and non-imaginative writing; the role of writing in the relationship between self and object; modes of imaginative and non-imaginative writing appropriate to the young writer; the impulse to expression in the young writer and its implications for the English-language arts curriculum; the inter-relatedness of writing and the other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep. 51.842, The English-Language Arts Curriculum or permission of instructor.*

### **51.846 English as a Second Language I**

First course in teaching ESL, introducing the basic linguistic, cultural, and psychological concepts. Analysis of current approaches to teaching ESL locally and internationally from the standpoint of diagnosis, grouping, use of particular methods, and materials. Observations of local ongoing ESL programs will be included. *Prep. 51.871 Reading and Language Disabilities I or permission of instructor.*

### **51.847 English as a Second Language II**

Second course in the ESL sequence which emphasizes innovative means in teaching ESL. Specific projects according to student need and interest will be developed; supervised clinical work. *Prep. 51.846 English as a Second Language I.*

**51.848 Language in the English-Language Arts Curriculum**

An examination of the multiple dimensions of language study in the English-language arts curriculum; the role of inquiry in the study of language and its implications for the English-language arts curriculum; theories of grammar and their relation to the study of language in the English-language arts curriculum; the inter-relatedness of language and the other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep. 51.842, The English-Language Arts Curriculum or permission of instructor.*

**51.849 Topics in English-Language Arts Education**

An investigation of a matter of immediate concern to English-language arts education, but for which no organized study is ordinarily available. Typical topics are: media in the English-language arts program; behavioral objectives in the English-language arts program; the English-language arts program for the disadvantaged. Each year the seminar topic for that year is announced prior to registration.

**51.851 Seminar in Current Issues in the Social Studies**

A content approach to problems of political, economic, and social significance which have contemporary relevance for teachers of the social sciences.

**51.853 History and the Social Studies in the School Curriculum**

Permits the student to explore some of the fundamental concepts of anthropology, sociology, economics, political science, and history. Emphasis will be given to the interrelatedness of disciplines and to the extraction of operating principles from those that aid in the analyses of social problems. As a consequence of such analysis, the student should be equipped to find a greater variety of conceptual relationships within the historical social science field. From there a framework for evolving courses of study can be generated. *Prep. teaching experience or certification.*

**51.854 Social Science Materials Seminar**

A curriculum course wherein the knowledge previously acquired will be used to establish criteria for the selection and development of curriculum materials. All materials of instruction will be viewed as means of implementation of objectives relating to specific social science concepts and skills. An effort will be made to personalize and concretize abstract phenomena and to demonstrate their impact on the quality of human lives. Students will examine and analyze prepared curricula and will be asked to develop original materials that include provision for the integration of a variety of thinking, reading, and social skills. *Prep. teaching experience or certification.*

**51.861 Principles of Programmed Instruction**

The development and current status of self-instructional devices. A survey of available programs and teaching machines, with emphasis on the details of the construction and evaluation of programs.

**51.863 Methods and Materials for Teaching Children I**

Teaching methods and learning materials used in teaching children in a number of educational settings. This course will help students establish objectives, plan and execute appropriate learning experiences, and evaluate outcomes. *Prep. must be taken concurrently with 51.800 Principles of Teaching. Offered Fall Quarter only. (Open only to students in the Nondegree Certification Program.)*

**51.864 Methods and Materials for Teaching Children II**

A continuation of 51.863. *Prep. 51.863 Methods and Materials for Teaching Children I; must be taken concurrently with 51.801 Curricula of American Schools.* Offered Winter Quarter only. (Open only to students in the Nondegree Certification Program.)

**51.865 Methods and Materials for Teaching Adolescents and Adults I**

Teaching methods and learning materials used in teaching adolescents and adults in a number of educational settings and for a number of purposes. The course will help students identify objectives, plan and execute appropriate learning experiences, and evaluate outcomes. *Prep. must be taken concurrently with 51.800 Principles of Teaching.* Offered Fall Quarter only. (Open only to students in the Nondegree Certification Program.)

**51.866 Methods and Materials for Teaching Adolescents and Adults II**

A continuation of 51.865. *Prep. 51.865 Methods and Materials for Teaching Adolescents and Adults I; must be taken concurrently with 51.801 Curricula of American Schools.* Offered Winter Quarter only. (Open only to students in the Nondegree Certification Program.)

**51.870 Developmental Reading and Writing**

Reading and writing as the receiving and generating of language; current developmental reading, writing, and related language skills; selected research findings bearing on relevant topics. Required of candidates for Master of Education in Curriculum and Instruction: Reading Certification; Curriculum and Instruction: English; Curriculum and Instruction: Language Arts. *Prep. permission of instructor.*

**51.871 Reading and Language Disabilities I**

Reading and language disabilities; causes and correlates of disability; language differences; aspects of measurement; diagnostic and corrective procedures in reading, writing, and related language skills; selected research findings bearing on relevant topics. Required of candidates for Master of Education in Curriculum and Instruction: Reading Certification; Curriculum and Instruction: English; Curriculum and Instruction: Language Arts. *Prep. 51.870 Developmental Reading and Writing.*

**51.872 Literature and Materials Seminar**

Literature for children, adolescents and adults; the sources of interest in literature as they relate to the reader; the interrelatedness of literature and the other components of the language arts program; investigation of materials available. Students will develop projects related to their needs and interests. Required of candidates for Master of Education in Curriculum and Instruction: Reading Certification; Curriculum and Instruction: English; Curriculum and Instruction: Language Arts.

**51.873 Reading Clinic I**

Practicum in clinical experience. Children and adults with severe reading disabilities will be tutored in the Reading Clinic twice a week for 1¼ hours each session, under close staff supervision. A one-hour seminar will follow each tutoring session for purposes of discussion and case presentation. A diagnosis, lesson plans, daily logs, complete case history, and a final progress evaluation will be required of each student. May be taken concurrently with 51.871. *Prep. 51.870 Developmental Reading and Writing.*

**51.874 Reading and Language Disabilities II**

Second course in Reading and Language Disabilities, including an examination of selected models of language processes; cognitive and affective dimensions; problems in language pathology; and other learning disabilities including academic, perceptual-motor, and neurological areas. *Prep. 51.871 Reading and Language Disabilities I and 51.873 Reading Clinic I.*

**51.875 Reading Clinic II**

A continuation of the Practicum. Requirements and format will be the same as Clinic I. May be taken concurrently with 51.874. *Prep. 51.871 Reading and Language Disabilities I and 51.873 Reading Clinic I.*

**51.876 Teaching Reading In Junior and Senior High School**

Developmental or corrective reading programs at the secondary level. Development of reading rate, comprehension, interpretation, and study skills in the content areas.

**51.877 Language and Reading**

The following topics will be examined as applied to the reading process and the teaching of reading: characteristics and systems of natural languages; development of the English language; language acquisition and dialectology. Selected models of language processes will be examined in light of recent linguistic theory. *Prep. 51.871 Reading and Language Disabilities I.*

**51.880 Evolution and Revolution in the School Curriculum**

Examination of the curriculum of the American school as an expression of conflict between subject-centered and student-centered curricula, traditionalists and revisionists, behaviorism and psycho-dynamism, and the interplay of forces generated by students, teachers, administrators, and other interested groups. Present school curricula will be analyzed as the outcomes of such conflicts and trends for the future development of school curricula will be hypothesized. *Prep. experience or certification.*

**51.881 The Dynamics of Curriculum Design**

Identification and analysis of problems in curriculum and instruction in light of the forces affecting the curriculum within the student's area of specialization; design and implementation of solutions to such problems; evaluation and field-testing where feasible, of these solutions. *Prep. 51.880 Evolution and Revolution in the School Curriculum.*

**51.882 Seminar: Ethnicity and Today's School Curriculum**

Students will briefly review aspects of the history and culture of some ethnic groups to explore the unique manner in which certain universal needs are manifested. Prepared curricular materials, as well as authentic literary, visual, and artifact materials, will be analyzed, evaluated, and related to developed criteria, goals, and potential curricular impact in projecting the aforementioned cross-cultural needs or themes. Students will be asked to select, organize, and as necessary, develop independent materials and strategies, appropriate for classroom use. Efforts will be made to categorize developed units of work on various ethnic groups which appear to have significant parallel dimensions according to predetermined categories.

### **51.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

### **51.894 Workshop in Supervision of Instruction** (6 quarter hours)

A workshop for teachers and other specialists in English, mathematics, science, social studies, and reading in schools and other educational institutions, which emphasizes the nature of the supervisory role and appropriate tasks for professional people overseeing the work of other professional people, at all levels of education. The workshop will focus upon the critical role of the relationship between supervisory functions and the quality of the performance and the needs for improvement of the individual being supervised. The supervising professional will be seen as a skilled, experienced, and sensitive person who can oversee the work of others as well as understand a great deal about the curriculum and the specific content, skills, and understandings it embraces, and how to communicate these to students. Will include a weekly seminar dealing with matters of a generic nature concerning the nature of supervision at all levels and within the total curriculum of schools or other educational programs and small group seminars. Participants may consider the problems related to more specific content areas and levels, and supervised field work.

### **51.895 Institute in Elementary Education**

(See general Institute description on page 122.)

### **51.896 Institute in Secondary Education**

(See general institute description on page 122.)

### **51.897 Workshop in Elementary Education**

(See general workshop description on page 123.)

### **51.898 Workshop in Secondary Education**

(See general workshop description on page 123.)

### **51.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

### **51.900 Cooperative Education in America**

An examination of cooperative education as a complex tool for achieving goals of education. Attention will be directed to its psychological implications for the individual, its social implications for the nation, and its place in educational thought. American higher education will be the principal focus of these considerations.

### **51.920 Methods and Materials in Adult Literacy Education**

This introductory course includes a review of current ABE programs around the country with particular emphasis on the programs in Boston, e.g., OIC (Opportunities Industrialization Center), New Urban League, WIN (Work Incentive Program), and public school programs for adults. This review of the programs will include a study



and some observation of ongoing programs in the area, especially the WIN program presently being run by the University. Specifically, students will discuss, observe, and study various approaches to ABE programs in terms of curriculum, methodology, materials used, groupings, and evaluation.

A major objective of the course will be to become more aware of the psychological problems of adult readers and nonreaders. Adult behavior and learning will be studied; the effects on learning of particular environmental forces (e.g., black ghetto, Indian reservation, rural-urban factors, etc.); methods of teaching adults at various levels will be studied and observed, as will a wide range of currently available books and materials for adult programs. All students may do some supervised clinical work with adults in the Reading and Learning Clinic; logs will be kept on the diagnostic and corrective work developed for each student. *Prep. permission of instructor.*

## EDUCATIONAL ADMINISTRATION

### **52.805 Simulated Problems: Secondary School Administration**

The workshop is designed to place each student in a simulated decision-making situation as a principal or administrator of a secondary school. Background materials have been prepared which describe all aspects of a school system, including its publics, its policies, its certified and noncertified staff members, and its geographical and socio-economic makeup. These background data are disseminated through motion pictures, film strips, and taped interviews with influential people in the community, as well as through written materials. *Prep. 52.810, 52.811, or permission of instructor.*

### **52.806 Directed Field Experiences In the Administration of the Elementary School**

Required of all master's candidates who major in school administration. Study and discussion of administrative functions will be coordinated with selected field trips to administrative settings and with guest lectures by practicing elementary school administrators. These experiences usually involve visits to such settings as: an elementary school, a middle school, a superintendent's office, a school committee meeting, and appropriate federal and state agencies. In addition, each student will be expected to participate in an administrative field experience in an elementary setting for a minimum of four hours per week. *Prep. 52.810 or permission of instructor.*

### **52.807 Directed Field Experiences In the Administration of the Secondary School**

A companion course to 52.806; required of all master's candidates in school administration. Study and discussion of administrative functions will be coordinated with selected field trips to administrative settings and with guest lectures by practicing secondary school administrators. These experiences are aimed at educational agencies at the secondary level and will include visits to a comprehensive high school, a junior high school, a regional vocational-technical school, a superintendent's office, a school committee meeting, and appropriate federal and state agencies. In addition, each student will be required to participate in an administrative field experience in a secondary school for a minimum of four hours each week. *Prep. 52.810 or permission of instructor.* (52.807 may be a continuation of 52.806 or may precede it.)

**52.808 Seminar In Educational Administration**

A culminating experience for students majoring in school administration at the master's level. A student is confronted with major issues facing the school and its administrators. Great emphasis is placed upon applying knowledge gained in previous administrative courses to an understanding of contemporary education problems. *Prep. 52.810, 52.811, or permission of instructor.*

**52.810 Leadership In Education, Part I**

Part I of a two-term core course designed to introduce the student to concepts of formal organization. This core, consisting of a two-part sequence, is prerequisite to further study in the Department of Educational Administration. Part I provides the student with an overview of formal organizations as social systems, with emphasis given to the leadership function. Relationships between individuals and organizations are considered. Communications and decision-making functions are analyzed and examined.

**52.811 Leadership In Education, Part II**

Part II continues an emphasis on the leadership function in organizations. It examines selected informal organization elements such as motivation, normative order, social power, conflict, conformity, and creativity. Attention is given to processes of change and innovation in organizations. *Prep. 52.810 must be completed before enrollment in 52.811.*

**52.813 Instructional Leadership: Curriculum Development and Supervision**

Views the responsibilities of administrative personnel relating to the improvement of curricular and instructional practices. Evaluative techniques, in-service education, supervisory procedures, and innovative programs are among the areas of consideration. Opportunities are extended for students to become engaged in supervisory projects individually or in small teams. *Prep. 52.810 and 52.811, or permission of instructor.*

**52.814 Simulated Problems: Elementary School Administration**

The workshop is designed to place each student in a simulated decision-making situation as a principal or administrator of an elementary school. Background materials have been prepared which describe all aspects of a school system, including its publics, its policies, its certified and noncertified staff members, and its geographical and socio-economic makeup. These background data are disseminated through motion pictures, film strips, and taped interviews with influential people in the community, as well as through written materials. *Prep. 52.810, 52.811, or permission of instructor.*

**52.815 Simulated Problems: Administration of Occupational and Career Education**

Each student is confronted with a series of simulated decision-making situations such as those which are usually faced by administrators of programs in the area of occupational and career education. Readings, audiovisual material, and class interactions constitute the design of this course.

**52.816 Seminar In Career Education**

Students will be confronted with a sampling of the major issues facing administrators and supervisors of occupational and career education programs in their efforts to organize, promote, and operate such programs. Emphasis will be placed on applying

the knowledge acquired in previous courses and other program experiences to arrive at an understanding of contemporary occupational and career education problems and their solutions.

#### **52.817 Design, Production, and Utilization of Instructional Materials**

Deals with all aspects of instructional media, surveying types, techniques, advantages, limitations, sources, and methods of use of materials and equipment in specified areas. Emphasis is on the selection of appropriate media to suit given learning objectives. Laboratory experience in operation of equipment and the production of instructional materials is provided.

#### **52.818 Developing Curriculum Learning Packages**

During this course each student will produce a self-correcting, self-pacing, self-directing learning package. Individualized programs currently using the concept of contract learning will be reviewed and evaluated.

#### **52.819 Introduction to Instructional Television**

Concerned with operation of an instructional television studio and the production of television programs for direct instruction. Each student will write, direct, and evaluate a short television program in any curriculum field and area of his choice.

#### **52.820 Principles of Programmed Learning**

Will cover the development and current status of self-instructional devices and programs. Students will survey available programs and teaching machines, with emphasis on details concerning construction, selection, evaluation, administration, and use of programs.

#### **52.821 Administration of Instructional Media Programs**

Addresses itself to the various aspects and problems involved in the management and operation of educational media programs. Public school, university, medical center, commercial, and industrial training program settings are considered in terms of service, instruction, and research.

#### **52.822 Foundations of Instructional Communications and Technology**

Introduction to the concepts and principles of the learning process, communications, multimedia instruction and instructional systems. Surveys will include programmed instruction, instructional television, games and simulation, audiotutorial laboratories, computer-assisted instruction (CAI), computer-managed instruction (CMI), curriculum learning packages, mediated teaching units, individualized instruction, performance contracting, validated instruction, and criterion-referenced testing. Discussion will involve problems of administration and economics of instructional communications and technology in school systems and training centers.

#### **52.823 Principles of Instructional Systems Development**

Introduction to the concept of a system as it relates to the instructional process. Each student will select a problem in any area of his choice and conduct a complete systems analysis and systems synthesis to resolve the problem. The contributions of the behavioral sciences as they relate to systems development will also be reviewed.

#### **52.824 Administration of Cooperative Education**

An examination of significant elements in the planning, implementation, and operation of a cooperative education program. Areas of concern include: agents for in-

stitutional change, intra-institutional relationships, program costs and funding sources, cooperative education calendars, development of cooperative work assignments, relationships with cooperative employers, and operational policies.

**52.826 Administration of the Elementary School**

A survey of the operational tasks performed by the elementary school administrator. Included will be: school-community relations, student personnel, staff personnel, curriculum and instruction, physical facilities, finance and business management, and organizational structure. *Prep. 52.810, 52.811, or permission of instructor.*

**52.827 Administration of the Secondary School**

A survey of the operational tasks performed by the secondary school administrator. Included will be: school-community relations, student personnel, staff personnel, curriculum and instruction, physical facilities, finance and business management, and organizational structure. *Prep. 52.810, 52.811, or permission of instructor.*

**52.828 Administration of Early Childhood Education**

This course will include the study of significant elements of administration unique to the planning, implementation, and operation of an early childhood education center. Areas of concern are funding sources, intra-institutional relationships, patterns for designing early childhood programs, on-site visitations, modes of private governance, use of plant, student and teacher placement, role of volunteers, and related topics. *Prep. 52.810 and 52.811.*

**52.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

**52.895 Institute in Educational Administration**

(See general institute description on page 122.)

**52.898 Workshop in Administration**

(See general workshop description on page 123.)

**52.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

**CAGS AND DOCTORAL COURSE OFFERINGS IN  
EDUCATIONAL ADMINISTRATION**

*(Open only to CAGS and doctoral degree candidates or by special permission of the chairman of the Department, granted prior to registration.)*

**52.830 Current Issues in Educational Administration**

A seminar required of all students pursuing the CAGS. Critical and contemporary issues which face school administrators will be examined closely. The status of the

administrator; federal, state, and local revenue sources; accountability; the voucher plan; teacher militancy; equal educational opportunity; conflicts with religious organizations; control of schools; urban education problems; cultural deprivation; and human rights are examples of topics that will be analyzed.

#### **52.831 Innovation and Change in American Public Schools**

A seminar required of all students pursuing the CAGS. Although major emphasis will be given to curriculum and instruction, attention will also be given to planned change in other critical areas such as team teaching, modular scheduling, nongradedness, educational parks, programmed instruction, in-service education, individualizing education, and teacher-learner relationships.

#### **52.832 The Process of Administration**

Simulation, case analysis, and role-playing will be utilized to gain insight into such topics as the improvement of organizational morale, professional job satisfaction, and current issues of involvement and conflict. Alternative courses of action are studied to cope with problematical events confronting educational administrators.

#### **52.834 Educational Finance**

The study of school finance deals with the principles and problems of financing education, and also considers the basic concepts of economics relative to the place of school finance in the field of public finance. The sources and rationale for public support of schools are examined. Selected state and federal aid programs, capital outlay programs, current practices and issues of local support, and bond issue campaigns are included in this study.

#### **52.835 School Business Management**

Practices and issues in the administration of school business affairs are the major concern of the course. The role of the school business administrator and the educational budget will be examined. Attention will be paid to principles of budget preparation and development, purchasing, supply management and distribution, school accounting and data processing systems, auditing, financial reporting and management of payroll, transportation programs, school food services, and the operation and maintenance programs for the physical plants. In addition, each student will be placed in a simulated decision-making situation. Background materials have been prepared which describe aspects of a fictitious school system, including its publics, policies, and other relevant information. Each student will have the opportunity to deal with matters typically faced by the school business administrator.

#### **52.836 Personnel Administration**

The purposes, patterns, and issues in personnel administration are the major considerations of the course. Study will include the skills, attitudes, and knowledge which an institutional staff needs to have and which are essential to the accomplishments of organizational goals. Personnel administration programs and problems of student personnel, para-professional, nonprofessional, and professional staff members will serve as the focus for the course.

#### **52.837 School-Community Relations**

This course includes the study and design of school-community relations programs based on the principles and practices of the intercommunications between the school and its several publics. Selected research findings relative to public relations

programs in business, industry, and governmental agencies will be reviewed in addition to those involving educational systems. Stress will be placed on the role of the administrator in the development of a comprehensive program of school-community relations for his administrative unit.

### **52.838 School Plant Planning, Operation, and Maintenance**

This course seeks to have the student develop a basic understanding of the processes involved in the planning, maintenance, and operation of school plants. Such items as educational specifications, the process of school construction, techniques used to provide clean, safe, and healthy environments for the teaching-learning process, along with the selection, assignment and supervision of custodial and maintenance staff will be involved. Statutes or regulations pertaining to these processes used by state and local regulatory bodies will also be reviewed.

### **52.840 Problems In School Administration: A Simulated Experience — The Superintendency**

### **52.842 Problems In School Administration: A Simulated Experience — Assistant Superintendent for Instructional Services**

These courses are designed to place each student in a simulated decision-making situation in his area of concentration. Background materials have been prepared which describe all aspects of a school system, including its publics, policies, certified and noncertified staff members, and the geographical and socio-economic makeup of the community. These background data are disseminated through motion pictures, film strips, and taped interviews with influential people in this community as well as through written materials.

### **52.843 Administrative Internship**

This is an individualized offering involving supervised observations, internships, externships, and seminars in educational administration, and it is designed to provide further practical experience in the student's area of administrative preparation. The administrative internship program must be worked out well in advance with the adviser.

### **52.844 School Law**

The student will be expected to develop a basic understanding of federal and state laws that apply to school systems, educational programs, and personnel, as well as of the legal prerogatives available to the practicing administrator and the local boards of education. This study will include consideration of the constitutional, statutory, and common-law foundations of educational systems and the school administrator's role with respect to them.

### **52.845 Seminar in Media Research and Learning**

Provides for surveys, critical analyses, and discussions of current research dealing with learning principles, communication theory, media, and instructional systems design. Oral and written reports are required. Experimental and field research are considered for additional credit in subsequent terms.

### **52.846 Developing Curriculum in Learning Packages — Advanced**

Using the instructional development techniques acquired in the introductory course,

students will design a more sophisticated learning package, field test it, and using the test data, revise the package until the predetermined criteria are met.

#### **52.847 Cataloguing and Classification of Instructional Materials**

The principles, codes, and techniques utilized in organizing both print and nonprint materials in an integrated collection. Emphasis on the application of bibliographic methods of control to films, records, slides, cassettes, kits, and other media. Acquaintance with the sources and tools listing instructional materials for the purpose of ordering them, and the development of the skill which assists the user in locating them.

#### **52.850—851—852 Doctoral Seminar in Leadership: Administration and Supervision I, II, III**

A series of three seminars required of all students pursuing the Ed.D. degree. The dialogues in these courses will use an interdisciplinary approach to explore complex behavioral and structural interactions found in formal organizations. Major emphasis will be placed upon integrating theoretical concerns with practical administrative functioning.

This sequence of seminars is viewed primarily as a pooling of the results of extensive individual student research and activities and is aimed at giving the student an overview of all aspects of the institution he will be leading.

#### **52.854 Organizational Analysis**

A course open only to students pursuing the Ed.D. degree, this course will include examination of different approaches used to define traits or characteristics of formal organization. Special emphasis will be placed on the application of models, typologies, and schemes to identify structural or procedural deficiencies in bureaucratic social systems.

#### **52.860 Academic Administration in Higher Education**

Recruitment of properly qualified faculty and staff is only one problem of the academic administrator. This course will also consider the problems of: pupil services, admissions, athletics, curriculum development, accreditation, instructional resources, registration and scheduling, faculty organization, continuing education, faculty rights and responsibilities, and personnel policies.

#### **52.861 Problems in College Administration: A Simulated Experience**

This seminar is designed to place each student in simulated decision-making situations as an administrator of a college or junior college. Background materials have been prepared which describe all aspects of a college including its policies, makeup of faculty and student body, its financial situation, the community it serves, and its board of control. These data are disseminated through motion pictures, film strips, and taped interviews as well as through written materials.

#### **52.862 Institutional Planning and Facilities**

This course will consider the planning of new colleges as well as the expansion and maintenance of existing ones. Systems analysis, needs surveys, and development of educational specifications for college facilities will constitute half of the course. The other half will involve the operation and maintenance of the physical plant, including provisions for housing, safety, parking, communications, and health service.

**52.863 Financial Management in Higher Education**

This course seeks to combine a knowledge of fundraising activities with the study of proper financial management in higher educational institutions. The problems of fundraising for both public and private, two- and four-year institutions will be considered. Modern techniques of budget preparation and control will include purchasing, school accounting, data processing, providing benefits for faculty, financial reporting, food services, housing, and operation and maintenance of physical plant.

**52.864 Typologies of Higher Education**

A study of the types of higher educational institutions, with emphasis on organizational structure, modes of governance, and administration. The history of higher education, particularly the development of colleges, universities, and junior colleges in the United States, will be considered to provide perspective for the modern college administrator. Important issues and the problems they presented for administrators will provide the major focus of this course.

**52.865 Systems Theory in Education**

This course will provide the student with an introduction to general systems theory and the implication of systems theory to leadership, administration, and supervision. The course will include examination of systems applications such as PERT, PPBS, and flowchart development. Special consideration will be given to systems study as a method of planning and evaluation.

**52.866 Politics and Educational Decision Making**

This course examines federal, state, and local governmental arrangements and political processes which influence educational policies of school systems. Emphasis is given to the application of political science concepts and research methods to educational policy-making processes and to the political environment surrounding the educational administrator.

**52.867 Administration of Adult and Continuing Education**

The historical development of adult and part-time education, with attention to the present status and trends for the future, will be studied, with emphasis on the administration of these programs. A variety of adult educational programs in schools, colleges, junior colleges, religious agencies, social service organizations, business and industry, and professional organizations will be included, focusing on planning, implementing, administering, financing, and evaluating such programs.

**52.868 The Community College**

Emergence of the community college movement in the United States; administrative structures and governance; the role of faculty in planning. The student population and related student personnel services will be examined. Particular emphasis is placed upon the identification and utilization of community resources in curriculum development and the college's total relationships with the community in which it exists. The two-year technical institute and both publicly and privately supported junior colleges will be studied. Field visits are an integral part of course requirements.

**52.893 Doctoral Dissertation**

*Prep. admission to candidacy in the Doctor of Education degree program.*

**52.899 Directed Study**

This experience is provided for the student whose unique academic needs or in-



terests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

## **COUNSELOR EDUCATION**

### **53.800 Philosophical Foundations of Guidance and Human Services**

The purpose of this course is to provide a philosophical and theoretical background for beginning graduate students in counseling. The course has three objectives: 1) to sharpen the "self as instrument" through study and discussion of established theories of helping as related to one's personal value system and through self-exploration and increased self-understanding in heretofore unexplored personal areas; 2) to introduce students to the broad spectrum of professional helping service areas with the intent of clarifying the students' professional roles; and 3) to begin to promote the development of a professional identity as a psychological helping professional.

### **53.801 Tests and Test Procedures**

The principles and problems of psychological testing as applied to the work of the counselor are discussed. Some consideration is given to technical concepts as they apply to the treatment, use, understanding, and interpretation of test scores. The student is made familiar with some of the currently used tests of intelligence, scholastic aptitude, differential aptitudes, achievement, interest, and personality. Tests are evaluated for use in education and guidance. Problems of test interpretation are emphasized.

### **53.802 Vocational Development and Occupational Information**

A dual-emphasis course dealing, first, with theories about how individuals make decisions concerning their choice of vocation, and second, with the kind of data which is needed to assist people with these decisions. This requisite data deals with the following areas: the relationship of social and economic change to occupational trends; the classification and description of occupational fields; methods of collecting, evaluating, filing, and disseminating vocational information; and the role of the counselor in fulfilling these functions.

### **53.804 Counseling Theory and Process**

A required course for all Counselor Education degree candidates which must be taken in the Fall Quarter concurrently with the beginning of Practicum. The course will provide the student, through self-instructional materials, with a basic cognitive understanding of several major theoretical approaches to counseling. Classroom content will help the student to become familiar with a wide range of individual counseling strategies; to develop listening, understanding, and communications skills; and to further probe his own self-understanding as a counselor. These skills and understandings will be discussed and simulated in the context of a variety of settings with a variety of clients. Role playing, case material, and audio and video materials will be utilized in the instruction. This course will not be open to special students, but may be elected by degree candidates in other departments in any quarter except the fall quarter.

### **53.805—806 Counseling Practicum I and II**

The counseling practicum is a supervised counseling experience extending over the

academic year. Although registration for this course occurs only during the Winter and Spring Quarters, students will actually begin their practicum in the Fall Quarter. Emphasis in the fall will be on small-group seminars dealing with counseling and other related matters. The Winter and Spring quarters will concentrate on the supervised counseling assignment. Assignment to practicum settings will be made according to the student's major area of concentration. Students must make themselves available a minimum of two days per week during the academic year (October to June) for placement in a field setting. Seminars will stress material germane to the student's major and will meet a total of 24 times during the year. (For administrative purposes, these practicum course numbers will apply to each of the following specific practicum placements: Elementary School Practicum, Secondary School Practicum, College, Mental Health and Rehabilitation Practicums.)

Part-time students must submit an application for practicum (available from the Department) by April 1, for approval to enroll in the practicum the following Fall Quarter. *Prep. 53.800 Philosophical Foundations of Guidance and Human Services and 53.804 Counseling Theory and Process, both of which may be taken concurrently with the beginning of practicum.*

### **53.807 Administration of Guidance Services**

An advanced-level guidance course designed to help meet the certification requirements for guidance directors in Massachusetts. The course will cover philosophies, principles, and methods of establishing and administering guidance programs in the public schools. Simulated materials are used to replicate actual guidance problems dealing with testing programs, budgeting, interpersonal relationships, and other practical matters.

### **53.808 Group Counseling**

An introduction to theory, principles, and techniques of counseling with groups of individuals at different levels of development and for varying purposes. A basic mode of approach will be to involve students in a genuine group counseling experience in order to understand the phenomenon of group experience. *Prep. 53.804 Counseling Theory and Process or permission of instructor.*

### **53.809 The College Student and the Campus**

The relationship between college students and their environment will be examined. Focus is on student rights, emotional concerns, and the search for identity. The impact of societal forces and nontraditional patterns of study on student behavior are stressed. Varying concerns of personnel services in different types of college climates, including the community college, are discussed. Current issues in higher education are examined as they relate to services to students.

### **53.810 Elementary School Guidance**

Required for elementary counseling majors, this course has three principal objectives: 1) to gain a theoretical understanding of the personal, social, academic, and vocational development of children between the ages of 5 and 12 years; 2) to conceptualize the roles, functions, and goals of the elementary school counselor; and 3) to begin to consider a variety of programmatic strategies to operationalize the goals of the elementary school counselor. Topics to be studied include values clarification, decision making, developmental guidance, major theoretical approaches to development, the issue of exceptionality, occupational information and vocational development, and confluent education. These topics are set in the context of the elementary school counselor's role as a counselor/consultant/coordinator for the total elementary school population.

**53.811 Family and Parent Counseling**

The family will be studied as an institution, as an arena of interpersonal transaction, and as a seedbed of both distress and health. Various modes of counseling families will be presented, together with the theoretical notions underlying their use. The course will also demonstrate counselor-parent relations in the context of the school setting. *Prep. 53.804 Counseling Theory and Process or permission of instructor.*

**53.812 Seminar In Student Personnel Work**

Relevant topics and cases for personnel workers and administrators in higher education will be discussed and studied in depth. Particular emphasis is placed upon the development of student personnel programs, budget planning and development, and staff relationships. The expertise of appropriate specialists is utilized.

**53.813 School Counseling Strategies**

Intended primarily for students who will counsel in school settings or other settings emphasizing work with children and adolescents. A broad range of approaches will be considered, including, but not limited to, behavior modification and Gestalt and Adlerian strategies. Special emphasis will be placed on the development of strategies designed to help alleviate typical school-related and developmental problems such as nonachievement, decision making, negative self-identity, and disruptive behavior. Consideration will also be given to the counselor's role as a consultant to teachers, parents, and administrators in effecting positive behavior change. *Prep. 53.804 Counseling Theory and Process.*

**53.814 Vocational Counseling Strategies**

Develops an understanding of the essential ingredients of a self-awareness program especially in relation to a person's role expectations in the world of work. Vocational counseling is viewed as dealing with the entire individual, including his values, underlying psychological needs and drives, and the influence of the environment on one's present level of development and career awareness. Other topics to be developed in this course will include counseling with females and nonachievers, the decline of the work ethic, community resource development, job placement, and information giving as a perceptual process. *Prep. 53.804 Counseling Theory and Process. The course is intended for a variety of client populations from adolescence through adulthood.*

**53.815 Rehabilitation Counseling Strategies**

Primary emphasis will be on the roles and functions of the rehabilitation counselor, relevant issues in the field, and an overview of the rehabilitation process. Special problems and techniques of counseling with the disabled (physical, mental, and behavioral disorders) will be examined through case studies and role playing. Disability in the context of social deviance will be discussed, and psycho-social approaches in understanding human behavior, including self-concept, social role theories, and rational-behavioral approaches, will also be examined. *Prep. 53.804 Counseling Theory and Process (This prerequisite is waived for Rehabilitation Administration majors.)*

**53.816 Psychological Counseling Strategies**

Focuses on a variety of strategies designed to alleviate problems of older adolescents and adults. Perceptual-Gestalt insight approaches and behavioral approaches to counseling will be analyzed for their effectiveness with a variety of psy-

chological problems. The context for considering this eclectic approach to psychological counseling will be communications theory and organizational psychology, with the latter being related to the effective delivery of counseling and mental health services. *Prep. 53.804 Counseling Theory and Process. This course is primarily intended for the student working with client populations in mental health settings and college counseling centers.*

### **53.818 Case Studies in Marriage and Family Counseling**

An advanced-level course for students with previous experience or preparation in marriage and family counseling. Skills to be emphasized will include 1) the preparation of case studies of family and marriage histories and current functioning; 2) the design of service, counseling, and referral programs based upon comprehensive studies of needs and resources; and 3) the practice of counseling strategies through role playing, taped interviews, and progress reports of current counseling activities. *Prep. 53.811 Family and Parent Counseling.*

### **53.820 Seminar in School Psychology**

This course provides an intensive analysis of philosophical, technical, and school administrative issues contributing to the professional identity and function of the psychologist in an educational milieu. Simulations, case studies, and research projects will be used to study these issues. *Prep. permission of instructor.*

### **53.821 Psycho-Educational Prescriptions**

This course will deal with methods of synthesizing psychological information into effective, individually appropriate educational plans. Specific applications of methods from previous courses will be discussed. *Prep. permission of instructor.*

### **53.824 Individual Intelligence Testing**

(6 quarter hours)

Preparation to administer, score, and interpret the Stanford-Binet Intelligence Test, the Wechsler Adult Intelligence Test, and the Wechsler Intelligence Scale for Children. Consideration will be given to the theories of intelligence upon which the tests are based and the use of the tests in educational and clinic settings. Students will be required to administer and score thirty tests, including some from each of the three tests included in the course. *Prep. 53.801 Tests and Test Procedures or permission of instructor.*

### **53.830 Seminar in Contemporary Issues in Counseling**

Intensive study of a selected topic in counseling such as counseling minorities, current research, sex counseling, transactional analysis theory and practice, behavioral counseling. Course objectives will vary according to the topic but may include a review of the literature, skill-building workshop and action projects. *Prep. 53.834, Advanced Theories of Behavior Change and/or permission of instructor.*

### **53.831 Advanced Group Counseling**

This course will be a continuation of the content presented in Group Counseling, placing greater emphasis on developing skill in conducting group counseling at a variety of age levels. Greater attention will be given to relevant readings and research on group process and methods for behavior modification. *Prep. 53.808 Group Counseling.*

### **53.833 Seminar in Counseling Supervision and In-Service Education**

Supervisory methods of improving the effectiveness of school counselors' skills in

counseling and other aspects of guidance work, of involving counselors in the improvement of the guidance program, and of enhancing the personal growth of the counselor. *Prep. master's degree in guidance or permission of the instructor.*

### **53.834 Advanced Theories of Behavior Change**

An advanced-level counseling course required of all CAGS students and designed to provide greater depth of cognitive understanding of a variety of approaches to counseling. Original readings from a number of major theorists will be required. A major goal of the course will be to identify the major similarities and differences of assumptions, goals, and strategies of the theorists studied, and to build a strong conceptual basis for a counseling eclecticism from this analysis. Some of the theorists studied will include Freud, Adler, Perls, Ellis, Glasser, Rogers, Sullivan, May, Frankl, Bandura, and Skinner. *Prep. at least two counseling courses emphasizing both theory and process.*

### **53.835 Psychodiagnostic Measures**

An advanced-level course in the use and interpretation of interest and personality measures for more clinically-oriented settings. The course will place heavy emphasis on the case study method. Some of the tests typically studied in this course may include the Minnesota Multiphasic Personality Inventory, the California Psychological Inventory, Edwards Personal Preference Schedule, the Semantic Differential, and various interest measures. The course will introduce the student to projective techniques, beginning with the sentence completion test. *Prep. 53.801 Tests and Test Procedures, Abnormal Psychology or Personality Theory, and permission of instructor.*

### **53.840—841 Advanced Field Work**

(8 quarter hours)

Required of all CAGS students. The student will be assigned a field work placement consistent with his major professional goal and/or the setting in which he intends to work. The activity of the field work will extend across the academic year from September to June and require a minimum of one and a half days per week, or the equivalent, in the field work setting. Seminars will meet on alternate weeks with additional individual supervision on campus. Supervision will also be provided in the field setting. Both quarters must be completed before credit will be given for the course. *Prep. Counseling Practicum or the equivalent in experience.*

### **53.843—844 School Psychology Field Work**

(8 quarter hours)

Required of all CAGS School Psychology majors. The student will be assigned a field work placement in a K-12 school system under the supervision of a certified school psychologist. The activity of the field work will extend across the academic year from September until June. The student will be required to put in a minimum of one and a half days (300 hours) in the field work setting during the school year. Seminars will meet regularly on campus with additional university faculty supervision. *Prep. School Psychology Practicum.*

### **53.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

### **53.893 Doctoral Dissertation**

*Prep. admission to candidacy in the Doctor of Education degree program.*

**53.895 Institute in Counselor Education**

(See general institute description on page 122.)

**53.898 Workshop in Counselor Education**

(See general workshop description on page 123.)

**53.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

**SPEECH PATHOLOGY AND AUDIOLOGY**

**55.803 Cerebral Palsy**

Neuromuscular involvements and concomitant language and speech disorders; intellectual deficits, psychological deviations, communicative disorders of a cerebral palsied population; testing, placement, and management of the cerebral palsied child and adult with emphasis on a multidisciplinary approach. *Prep. permission of instructor.*

**55.804 Aphasia**

The neurological terminology related to the processing of language; neurological communication model, communication modalities and what resultant effects occur from lesions; the relationship between linguistics and psycholinguistics. Analysis of language of an aphasic patient. *Prep. permission of instructor.*

**55.805 Seminar: Voice Disorders**

Physiology and neurology of the laryngeal mechanism; the laryngoscopic examination. Voice disorders as learned behavior as a result of organic, neurological, and psychological deviation. Evaluation, referral, and management. *Prep. permission of instructor.*

**55.806 Language Disturbances in Children**

This course will emphasize current theories in language behavior and their practical application to the assessment and remediation of language disturbances in children. Lectures, discussions, and workshops will focus on the following issues: what constitutes a language problem, what assessment tools and teaching techniques are currently available, and what underlying principles are involved in selecting and sequencing the content of a remediation program. *Prep. 55.812 Differential Diagnosis in Speech and Language Pathology and 55.816 Test Procedures in Speech and Language Pathology or permission of instructor.*

**55.811 Clinical Management in Stuttering**

This course will emphasize diagnostic techniques, a review of the current therapeutic approaches, consideration of the individual's need in therapy, and the process of behavioral and attitudinal change. Also to be considered are termination, referral, and group therapy. *Prep. permission of instructor.*

**55.812 Differential Diagnosis in Speech and Language Pathology**

Evaluation, interpretation, and integration of test results; the application of standard

psychological tests to speech and hearing disorders; analysis of patients' premorbid and morbid histories, medical and psychological diagnoses; design and execution of therapeutic procedures; proper referral techniques and report writing; practicum situation. *Prep. 55.816 Test Procedures in Speech and Language or permission of instructor.*

### **55.813 Advanced Clinical Practice** (8 quarter hours)

Supervised clinical practicum in speech pathology and audiology in the Northeastern University Speech and Hearing Clinic and medical settings, educational settings, and rehabilitation centers. A minimum of 150 clock hours of experience with patients to extend over a three-quarter time period is required. An "I" grade will be awarded until all the requirements are met and then a pass-fail grade will be awarded. This course requires attendance at on-campus seminar meetings held twice a month. *Prep. 50 clock hours of clinical experience and permission of the clinical staff.*

### **55.814 Clinical Audiometry I**

The use of pure tone and speech reception instrumentation and hearing aid evaluation; the results and interpretation in the diagnosis of functional and organic disorders. Lectures, demonstration, observations, and practicum. *Prep. Introduction to Audiology and consent of instructor.*

### **55.815 Clinical Audiology**

The process of identification and evaluation of hearing loss. Differential diagnosis. Tests for conductive, sensorineural, and retrocochlear involvements. A consideration of research findings in the area of hearing aid selection, auditory training, lip reading, and language training for hearing handicapped individuals. *Prep. Introduction to Audiology (see undergraduate Education catalog) and permission of instructor.*

### **55.816 Test Procedures in Speech and Language Pathology**

Procedures in evaluating organic and functional communication disorders using standard and nonstandard speech and language tests in University clinic situations. Demonstration and application of techniques and objective reporting. *Prep. permission of instructor.*

### **55.817 Advanced Anatomy, Neurology, and Physiology of Speech-Hearing Mechanism**

Lectures and demonstrations by medical personnel. Emphasis on the head and neck. Admission by consent of adviser and medical supervisor. For advanced standing students. *Prep. Anatomy, Neurology, and Physiology at Speech and Hearing I; Introduction to Audiology; Pathologies of the Ear and permission of instructor.*

### **55.818 Pathologies of the Ear**

Lectures and observations in the organic and neurological pathologies of the ear; i.e., otitis media, Meniere's disease, and otosclerosis. Consideration of approaches to treatment (medical setting). *Prep. permission of instructor.*

### **55.819 Clinical Audiometry II**

Specialized techniques (Bekesy, FGSR, EEG, group testing, and screening); the results and interpretation in the diagnosis of functional and organic hearing disorders. *Prep. Introduction to Audiology and Audiometry I, lectures, demonstration, observations, and practicum; permission of instructor.*

**55.820 Physiological Acoustics**

Particular emphasis is placed on the biophysics of the hearing mechanism, especially in terms of actual clinical utility. Comparative anatomy and physiological analysis and dissections will accompany many of the class lectures. *Prep. introductory courses in Speech and Hearing, 55.815 Clinical Audiology, and permission of instructor.*

**55.821 Seminar In Audiology**

Advanced study of the rationale and development of principles associated with special procedures and methods used in audiology. *Prep. permission of instructor.*

**55.822 Seminar in Oro-Facial Anomalies**

Course material will be presented via lectures, class discussions, and frequent visits to and participation in several plastic surgery clinics. Guest lecturers in the areas of plastic surgery, genetic counseling, and otolaryngology will be invited to participate in the course. Major content areas will be embryology, etiology, cleft lip and palate, and other syndrome classifications; speech and language considerations; surgical, dental, and otologic considerations; psychological and social considerations; and an analysis of the total team habilitative effort. *Prep. Anatomy and Physiology of the Speech Mechanism and permission of instructor.*

**55.823 Psycho-Social Aspects of Communication Disorders**

This course is concerned with the psychological and social aspects of organic and nonorganic communication disorders. It will include personality dynamics in aphasia, cleft palate, cerebral palsy, deafness, and other primarily organic disorders, and psychogenically motivated disorders such as stuttering, language, and articulation. *Prep. permission of instructor.*

**55.824 Seminar In Speech Pathology**

Individual research and/or critical review of the literature in some area of basic science, speech sound learning, language, voice, fluency, or multiple disorders. Class presentations of material and class discussion will be included. *Prep. open to graduate students who have completed the equivalent of two quarters of graduate work in Speech Pathology and who have permission of the instructor.*

**55.860 Aphasia Rehabilitation**

Emphasis on current attitudes toward therapy and new methods, clinical methods of evaluation which are preparatory to therapy, and observation of therapeutic methods. *Prep. 55.804 Aphasia and permission of instructor.*

**55.861 Neuropathology**

The intricacies of neurological disease. Application of functional neuroanatomy in comprehending the various disease processes involving the nervous system. Derangements of speech with a neurological basis; an understanding of the disease process in relation to the diagnosis and treatment of patients with neurological diseases: cerebrovascular disease tumors or malformations, Parkinson's disease, multiple sclerosis, and others. Case presentations, neuroanatomy, laboratory experience, and analysis in the hospital environment. *Prep. permission of instructor.*

**55.862 Psycho-Acoustics**

Particular emphasis will be placed on masking, frequency vs. intensity relationships, evoked response procedures, brief tone and temporal integration, binaural summa-



tion, impedance foundations, and general behavioral responses to sound stimuli. *Prep. Introduction to Speech and Hearing, 55.815 Clinical Audiology, 55.820 Physiological Acoustics, and permission of instructor.*

#### **55.863 Advanced Study In Articulation Disorders**

An exploration into advanced theories of normal and abnormal phonological development with emphasis on distinctive feature theory and phoneme theory; direct application of theories to diagnosis and treatment of various phonological disorders. *Prep. undergraduate course in articulation disorders and permission of instructor.*

#### **55.864 Parent Education In Communication Disorders**

This course is designed to develop the student's understanding of the role of the parent in the therapeutic process. Content of the course includes various approaches to parent education, including group therapy, client-centered counseling, and filial therapy. *Prep. 55.823 Psycho-Social Aspects of Communication Disorders and permission of instructor.*

#### **55.865 Seminar: Speech Science**

Major topics will include the physics of sound generation and modification via the vocal tract, the biophysiology of respiration for phonatory processes, electromyographic techniques and biopotential recording systems, laryngeal and articulatory function, coupling, nasality, and X-ray procedures (head plate analysis). Neural innervation and vascular supply will be considered in conjunction with each muscle discussed. *Prep. course in speech science, 55.817 Advanced Anatomy, and permission of instructor.*

#### **55.866 Hearing Science Seminar**

Individual research and/or critical review of the literature in the areas of bone conduction of auditory signals, evoked response and audiometry, impedance and audiometry, cortical processing of auditory input, and other related topics. Students will be responsible for class presentations of researched material. *Prep. permission of instructor.*

#### **55.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

#### **55.895 Institute In Speech Pathology and Audiology**

(See general institute description on page 122.)

#### **55.898 Workshop In Speech Pathology and Audiology**

(See general workshop description on page 123.)

#### **55.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

*Teaching the Deaf*

**55.825 Teaching Speech to Deaf Children**

Utilization of vibration, visual aids, kinesthetic and proprioceptive cues, residual hearing and imitation in combination, to elicit intelligible speech from the deaf.

**55.826 Teaching Language and Reading to Deaf Children**

Modern methods in use, such as the Fitzgerald Key and the Natural Language Approach. Emphasis on how to use language in natural situations through lip reading and writing, with later emphasis on the formal presentation of language principles.

Methods used to develop reading experiences that focus on content rather than mechanics. Development of a balanced reading program that will provide adequate motivation, provision for evaluation, a wide variety of rich materials, and a well-organized sequence of reading experiences.

**55.827 Methods and Materials in Deaf Education**

Special methodologies in teaching the deaf. A wide view of the field and a comprehensive consideration of methods and materials. Emphasis placed on how to provide concrete experiences and activities, trips, and demonstrations to assist the child in understanding. There will also be demonstrations in the use of visual and auditory aids.

**55.828 Aural Rehabilitation**

Various speechreading methods, auditory training techniques, and materials. An integrated approach to the treatment of the hearing handicapped.

**55.852 Practicum: Teaching of the Deaf**

(8 quarter hours)

An opportunity for observing and teaching deaf children at various levels, under regular supervision in the Beverly School for the Deaf.

**REHABILITATION ADMINISTRATION AND SPECIAL EDUCATION**

*Rehabilitation Administration*

**56.950 Introduction to Rehabilitation**

An overview of and orientation to the field of rehabilitation, including its historical development, legislative involvement, psychological implications, and sociological dimensions. Emphasis is placed on coordinating and integrating services as they relate to the field of rehabilitation as a community process.

**56.951 Principles of Medical Rehabilitation**

The wide spectrum of disabilities that could profit from rehabilitation, including orthopedic, neurological, medical, surgical, and mental disabilities. Basic principles of medical rehabilitation important for the administrator to know will be presented. Psychological aspects of disability will also be discussed.

**56.952 Rehabilitation and Social Services**

The use of vocational rehabilitation as an effective rehabilitation process in federal, state, and private agencies as supported and encouraged by the most recent social and rehabilitation services legislation. This will include use of the rehabilitation model in programs for the physically handicapped, mentally retarded, emotionally disturbed, aging, welfare populations, youthful offenders, culturally disadvantaged, and

other special community programs. There will be emphasis on the administrative involvement in developing and supporting the diagnostic, evaluative, counseling, and placement procedures used in such rehabilitative programs.

#### **56.953 Organization and Administrative Theory**

The body of conceptual knowledge regarding organizational and administrative theory will be examined. Formal and informal organizations, organizations as social systems, status and role concepts, leadership in organizations, power structure, relationships to authority, decision making, and communication in and between organizations. An organizational analysis will be made of all the different types of rehabilitation settings currently in use.

#### **56.956 Community Planning in Rehabilitation**

What the administrator needs to know about community planning to plan a program in his area. Basic principles of community planning, community organization, and community dynamics, as well as interdisciplinary relations in rehabilitation. Examples of community planning from different rehabilitation agencies and the referral process among these agencies will be studied.

#### **56.957 Federal-State Relations in Rehabilitation**

The complex network of federal-state relations and their implications for rehabilitation. Grant procedures, matching formulas, public relations and VRA directives, state and federal legislation pertinent to rehabilitation.

#### **56.958 Social Welfare and Rehabilitation**

Acquainting rehabilitation administrators with the broad field of social welfare. The course will review the historical backgrounds of the relationship between vocational rehabilitation and social welfare and the more recent fast-moving developments in the relationship of these fields.

#### **56.959 Rehabilitation Research**

The emphasis in this course will be on administrative research, program evaluation, grantsmanship, etc. In addition, students will have the opportunity to develop a research design on some aspect of rehabilitation administration and carry out the necessary research operations involved.

#### **56.960 Practicum in Rehabilitation Administration**

(8 quarter hours)

Students will be assigned to a variety of rehabilitation agencies for their practicum experience. Problem solving relevant to experiences encountered in internship. A seminar will be regularly conducted by a senior faculty member in conjunction with the practicum experience. This seminar will enable students to share their field work experiences and resolve problems in rehabilitation administration which are connected with their field placements. (Students are expected to be available one-half day in the Fall Quarter and two days in the Winter, Spring, and Summer Quarters.)

#### **56.961 Rehabilitation Administration I**

An in-depth study of management practices within a rehabilitation organization from a behavioral standpoint. Areas to be covered include need surveys, goal-setting practices, job descriptions, recruitment, staffing, training, professional development, caseload management, program planning, utilization of research, community relations, leadership patterns, performance appraisal, and external relationships. Special cases will be used in classroom exercises.

**56.962 Administration of a Sheltered Workshop**

Special problems of administering a sheltered workshop, such as community planning, work evaluation, job-training, labor relations, contracting, production, and occupational placement.

**56.963 Rehabilitation Administration II**

Understanding the fiscal management of the typical rehabilitation setting, including basic rehabilitation agency accounting, planned program budgeting, disbursements, cost-analysis, contracting, taxation, forecasting, and funding. The implication of data processing for fiscal management will be covered in the course. Special problems will be assigned during the course.

**56.964 Rehabilitation and the Law**

This course is designed to sensitize rehabilitation administrators to the impact of legislative developments upon the field of rehabilitation. Special emphasis will be placed on understanding the legal implications for rehabilitation of the latest Vocational Rehabilitation Administrative Amendments, workmen's compensation laws, eligibility determination criteria, and Social Security Amendments.

**56.965 Occupational Placement**

A study of the dynamics of moving the rehabilitation client into the world of work within the framework of the specific community structure. Development of facility in use of resource materials in occupational information, job description and analysis, performance appraisal, training, and vocational assessment. The personnel point of view toward the handicapped will be discussed and analyzed, and more effective placement practices will be developed.

**56.980 Psychological Problems of Disability**

An advanced course in psycho-pathology as it relates to impact of disability on personality. In-depth study of the disabled, from the viewpoint of psychosocial factors, interpersonal relationships, and cognitive versus noncognitive functioning in those with motor and sensory disabilities; problems of dependency and motivation; role of psychosomatic factors.

**56.981 Administrative Problems in Rehabilitation**

Seminar designed to analyze, in depth, critical issues and selected rehabilitation problems. Operations and systems research as applied to rehabilitation will be highlighted. Students will make use of institute research studies and studies available through Social and Rehabilitation Services, completed research, and demonstration projects.

**56.982 Essentials of Case Management and Supervision**

The relationship between case management and casework supervision will be explored. Topics covered will be dynamics of the communication process, decision making, conflict, resolution and compliance, management of resources external to the organization, and structural and functional analysis of supervisory process. Management of case load.

**56.983 Rehabilitation of the Alcoholic and Drug Dependent**

A study of comprehensive factors, including the nature of etiology dynamics involved in alcoholic and drug dependency; techniques for evaluation; rehabilitation administration, planning, and treatment.

**56.984 Rehabilitation of the Penal Offender**

The rehabilitation of the penal offender will be examined from an eclectic point of view. Psychodynamic elements will be stressed, as well as social factors in the etiology, evaluation, treatment and rehabilitation seminar planning and administration.

**56.985 Rehabilitation of the Geriatric**

This course will present a comprehensive treatment of the problems, dimensions, and parameters involved in the administration of the various services and facilities for the rehabilitation of the geriatric. Special emphasis will be placed on the rehabilitation philosophy versus disengagement.

**56.986 Critical Issues in Rehabilitation Administration**

This course will be built around the exploration and in-depth discussion of current issues which are highly problematical to the field. Among these issues are the breadth of the concept of disability, appropriate training sequences for the various rehabilitation disciplines, the resolution of conflict over role overlap among disciplines, appropriate models for service delivery systems, etc. The most current and relevant research will be brought to bear upon these areas, as well as knowledge from the reservoir of experience of instructors, visiting experts, and the student participants themselves. Students will be prepared to cope with these issues as they exist in the profession and in the community. A theoretical orientation frame of reference will be brought to bear upon problems wherever feasible.

**56.991 Thesis**

A research activity that may be elected by the student in lieu of two electives (8 quarter hours), with the approval and recommendation of the adviser.

**56.993 Doctoral Dissertation**

*Prep. admission to candidacy in the Doctor of Education degree program.*

**56.995 Institute in Rehabilitation Administration**

(See general institute description on page 122.)

**56.998 Workshop in Rehabilitation Administration**

(See general workshop description on page 123.)

**56.999 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

*Special Education*

(For sequence requirements refer to Fields of Study)

**56.801 Alternatives for Providing Services for Special Needs Children**

A course for those involved in the regular classroom, special education, pupil personnel, and administration. Models will be provided for decision making and program evaluation with reference to appropriate research. The consultative role of

the special educator will be defined and developed. There will be interaction with members of varied and allied disciplines who provide services for special needs children.

#### **56.807 Learning Disabilities**

This course surveys behavioral characteristics of children who present specific deficits in perceptual, integrative, or expressive processes which impair learning efficiency. Discussion of diagnostic techniques, curriculum materials, learning style and teaching methods will be combined with observation. Students will be expected to work with a learning disabled individual.

#### **56.808 Current Methodology and Research in Learning Disabilities**

This is an advanced course which will develop the following competencies in relation to learning disabled individuals from early childhood through adulthood: use of task analysis and learning style to develop comprehensive individual education plans (refinement of skills developed in 56.807); use of current research to evaluate techniques of intervention (e.g., behavior modification and drug therapy for hyperactive children); use of current research to evaluate assessment techniques (e.g., effectiveness of available tests for learning disabilities); ability to administer, score, and interpret tests useful in identifying learning disabilities; use of prescriptive techniques and materials for learning disabilities. Selection of topics within competency areas will be individualized for students based on previous course work and experience.  
*Prep. 56.807 Learning Disabilities and 50.815 Research Design in Education*

#### **56.809 Development and Implementation of Programs for Learning Disorders**

This advanced course develops required skills for resource room and diagnostic-prescriptive teaching personnel and consultation in the regular classroom. Projects for the course include some of the following: needs assessment for various special needs programs; development of a screening and diagnostic test battery; development of a diagnostic-prescriptive procedure for a specific population; development of in-service programs; development of a plan for educational group management. Projects will be selected by students according to their particular needs. Students in this course should be experienced in working with individuals with special needs.  
*Prep. 56.807 Learning Disabilities and 56.846-847 Special Needs: Measurement, Methods, Materials.*

#### **56.831 Teaching the Emotionally Disturbed**

A study of approaches used to deal with behavioral disorders. Emphasis will be on classroom management techniques, use of consultation, and parent-teacher interaction.

#### **56.832 Group Dynamics**

Emphasis on understanding group growth, behavior, and action fundamental to developing solutions to the complex problems of group life. Students will learn to examine their strengths and weaknesses, to make decisions, to become alert to new ideas and actions, to discover the pulse of a group, and analyze reasons for being productive while another group may be nonproductive. The group will examine such areas as sociodrama, sociometric techniques, attitude testing, social action project development, and communication blocks in human relations.

**56.833 Mental Health**

Study of conditions leading to optimal social adjustment. Consideration of the relationship between the maturation process and mental health, possible predeterminants of maladjustment, and factors which encourage the attainment of emotional maturity. Special emphasis will be paid to the role of the school. Contributions from the fields of psychiatry, psychology, sociology, physiology, and medicine will be synthesized and evaluated.

**56.834 Case Conferences on Emotionally Disturbed Children**

This course will be conducted as a seminar in connection with the student's practicum. Case presentations by outstanding resource persons will be thoroughly examined and discussed. Students will also be expected to make their case presentations to the seminar. *Prep. 50.807 Abnormal Psychology, 56.831 Teaching the Emotionally Disturbed.*

**56.835 Socio- and Psychodynamics of Family Life**

A consideration will be given to the internal and external dynamics of family life and the significance of such dynamics to the mental health of the handicapped child. Approaches to working with parents are explored. Emphasis will be on impact of disability on family functioning and integration.

**56.837 Seminar: Problems of the Emotionally Disturbed Child**

This course will be devoted to an intensive study of the special problems of the emotionally disturbed child. It will provide an opportunity to proceed in depth in areas of special interest to the seminar students. Special attention will be paid to problems presented by the autistic child, the neurotic child, the child with character disorders, the child with psychosomatic disorders, and the multi-handicapped child. *Prep. 56.880-881 Etiology and Development of Deviations in Special Needs Individuals.*

**56.838 Development and Implementation of Programs for the Severely Handicapped**

Course work will include observation of severely handicapped children in the classroom, demonstration of evaluation and assessment techniques, and development of educational plans for a severely handicapped child. *Prep. 56.840 Psychology of Mental Retardation and Other Handicapping Conditions, 56.846-847 Special Education Methods and Materials Related to Measurement and Evaluation (may be taken concurrently), 56.839 The Severely Handicapped.*

**56.839 The Severely Handicapped**

A review of handicapping conditions and consideration of the implications of severe multiple handicaps. Students will develop a case study of a severely handicapped person in conjunction with a review of relevant literature. *Prep. either 56.880 Etiology and Development of Deviations in Special Needs Individuals or 56.840 Psychology of Mental Retardation and Other Handicapping Conditions, or permission of the instructor.*

**56.840 Psychology of Mental Retardation and Other Handicapping Conditions**

A study of the social and emotional adjustment of handicapped children and of the psychological significance of mental, sensory, and motor variations in the adjustive process. The effects of limitations imposed by attitudes of society, the attitude of the

individual toward his handicap, and the effect of the handicap itself are evaluated. Implications for educational programs are analyzed. (This course should be among the first taken in the Special Education sequence.)

#### **56.841 Development and Implementation of Programs for the Moderately Handicapped**

Development and implementation of programs for the moderately handicapped will be discussed; classroom observation of moderately handicapped children, demonstration of evaluation and assessment techniques, and development of educational plans for one or more moderately handicapped children will be projects for the course. *Prep. 56.840 Psychology of Mental Retardation and Other Handicapping Conditions, 56.846-847 Special Education Methods and Materials Related to Measurement and Evaluation (may be taken concurrently).*

#### **56.843 Evaluation and Education of the Vocationally Handicapped**

Designed to develop fundamental skills in the evaluation and teaching of activities related to the vocational development of disabled individuals. Work sample and other techniques will be used to assess levels of skills. Focus will be on activities such as home management, use of tools, household repairs, basic sewing, essentials of food preparation, and activities of daily living (ADL). Visits will be made to sheltered workshops and vocational adjustment centers.

#### **56.845 Rehabilitation and the Special Education Teacher**

This course is designed to develop effective working relationships between rehabilitation professionals and special education teachers. Elementary and secondary school personnel concerned with children with special needs will also find the course pertinent. Consideration will be given to current legislation (Massachusetts Chapter 766) and its implementation, the teacher's role in rehabilitation, and understanding of the total rehabilitation process, and rehabilitation resources available to school personnel.

#### **56.846 Special Needs: Measurement, Methods, and Materials I**

Competencies will be developed in observation, recording, and analysis of children's behavior and learning environments including continuous measurement and informal assessment of mild and moderate special needs. Students will master strategies of applied behavior analysis including precision teaching and contingency management.

#### **56.847 Special Needs: Measurement, Methods, and Materials II**

Competencies will be developed in formal assessment techniques and in related instructional materials and methods in language arts, mathematics, and perceptual-motor skills. Students will be expected to work with individuals having mild to moderate special needs to develop the skills outlined above. *Prep. 56.807 Learning Disabilities and 56.846 Special Needs: Measurement, Methods and Materials I, or permission of instructor.*

#### **56.848 Early Childhood Learning Problems — Identification and Program Development**

Informal and formal screening and assessment procedures suitable for an early childhood population will be evaluated. Students will be required to work with young children in order to acquire experience with screening and assessment techniques.



The resulting information will then be used to develop programs to meet the needs of individual children. *Prep. 56.846 Special Education Methods and Materials or equivalent.*

### **56.849 Special Education for Gifted Children**

Identification, characteristics, and problems of gifted, creative, and talented children and youth. Emphasis on administrative and instructional adjustments needed to provide for this group of exceptional children.

### **56.850 Field Work and Seminar with Special Needs Children**

### **56.851 Student Teaching and Seminar with Special Needs Children**

(4 quarter hours each)

Courses designed to satisfy present Massachusetts requirements for teaching children with special needs.

The courses extend over a full year in a series of experiences as observer, tutor, and teacher. Students must make available approximately 250 hours or two days per week for two quarters for field work, then approximately another 250 hours or four days per week for one quarter for student teaching. Students who are employed and who cannot devote full days to satisfy these requirements must arrange to be available evenings, weekends, and summers. Provision for attendance at biweekly seminars must also be made. Seminars are for the purpose of discussing with other students and professors issues in teaching special needs children, which arise in the field. Outside speakers and programs will be arranged to extend this dialogue.

Students who are certified, have a Letter of Approval, or are eligible for the latter from the Massachusetts State Department of Education as a Special Needs teacher may not be required to student teach. Student teaching in another area of special needs or an appropriate elective course may be substituted with the written approval of the student's academic adviser.

Approval of the academic adviser, in writing, will be required before the student can do field placement or student teaching. Approval, in writing, of the academic adviser will be required prior to obtaining a waiver of student teaching.

All students, regardless of past experience, certifications, or letters of approval, will do approximately 250 hours of field work set up and supervised by the University.

### **56.853 Field Work and Seminar**

### **56.854 Practicum in Special Education**

(4 quarter hours each)

Courses designed to satisfy Department requirements for field experience and extended practicum for SECP or other students who do not need certification. The courses extend over a full year and cover a series of experiences. Students must make available a minimum of two days per week for the first two quarters and five full days per week for the third quarter. Application for field placement is made two quarters prior to that for which field work is planned. Part-time students who are employed will need to make provision for evening, weekend, or summer assignments to satisfy the requirement for field experience, and a full quarter of field work, five days per week. Provision for attendance at seminars must also be made.

### **56.870 Administration and Supervision of Special Education**

Designed for advanced graduate students preparing for administrative or supervisory positions in special education programs. Facilities and curriculum adjustments, staff roles, methods and content for in-service training, and the use of the team approach are studied. Field trips to observe and evaluate programs are required. *Prep. 52.810, 52.811 Leadership in Education I & II.*

**56.880-881 Etiology and Development of Deviations in Special Needs Individuals** (8 quarter hours)

The first quarter (56.880) will concentrate on factors which primarily affect deviations in cognitive, motoric, and physical development. Understanding of these factors will be used to discuss multidisciplinary life-management issues relating to Down's Syndrome, cerebral palsy, and other common conditions.

The second quarter (56.881) will concentrate on factors which primarily affect emotional development. Psychobiological, psychodynamic, and learning theory approaches will be discussed and related to problems of life-span management. Community programs will be analyzed in addition to the more traditional intervention techniques.

**56.882 Seminar in Mental Retardation**

A study of research in the field and its implications for teaching. Intervention strategies will be studied and evaluated.

**56.891 Thesis**

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

**56.893 Doctoral Dissertation**

*Prep. admission to candidacy in the Doctor of Education degree program.*

**56.895 Institute in Special Education**

(See general institute description on page 122.)

**56.898 Workshop in Special Education**

(See general workshop description on page 123.)

**56.899 Directed Study**

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the Department. *Prep. approval of the Chairperson of the Department and of the Director of the Graduate School of Education. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

## INSTITUTES

**50.895, 51.895, 51.896, 52.895, 53.895, 55.895, 56.895, 56.995**

A department may offer a special institute in a specific field of interest from time to time. The institute may be a collaborative one offered by the several departments in the College of Education and will usually include a special institute faculty drawn from resources outside the University, as well as from the College of Education faculty. The institute will focus on a specific area of academic study and may be interdisciplinary in nature; it involves total time commitments on the part of participants in morning, afternoon, and evening sessions five or six days per week for one to eight weeks, depending upon the nature and scope of the institute. Institutes are customarily designed for participants who are currently employed in a common field of work and who are desirous of receiving additional preparation in new methods, new materials, and new content areas. Graduate credit will be granted for successful completion of an institute but may not be applied toward a degree program at the

University without the approval of the department in which the student is doing his major field of specialization degree work. All institute participants must be degree candidates in the Graduate School of Education or must qualify, prior to registration, as special graduate students. *Prep. permission of institute instructor.*

## WORKSHOPS

**50.898, 51.897, 51.898, 52.898, 53.898, 55.898, 56.898, 56.998**

A department may offer a special workshop in a specific field of interest from time to time. Emphasis in the workshop will be focused on development of instructional materials or resolution of practical problems within a single school or institutional setting, or for a group of potential workshop participants who are currently employed in a common field of work. Graduate credit will be granted for successful completion of a workshop but may not be applied toward a degree program at the University without the approval of the department in which the student is doing his major field of specialization degree work. All workshop participants must be degree candidates in the Graduate School of Education or must qualify, prior to registration, as special graduate students. *Prep. permission of workshop instructor.*

## INTERDEPARTMENTAL COURSES

### **93.801 Seminar In Early Childhood Education Theory and Practice**

The seminar will provide students with the opportunity to focus on issues not specifically covered in other course work. Consideration will include such topics as: health and nutrition, diagnosis of childhood diseases, classroom organization and management, referral of children with special problems, licensing, financing, and the like. Emphasis on all these topics is relative to early childhood education and settings. Specialists on the various topics will assist in seminar teaching.

### **93.802-803 Practicum in Early Childhood Education I and II (8 quarter hours)**

The early childhood practicum is a supervised teaching experience extending over three consecutive quarters, although students will register for this for only two quarters. To fulfill the requirement, students must meet in practicum seminars for a total of twenty-four times during the placement. Assignment to practicum settings will be made through the Director of Field Placement in association with the practicum adviser. Practicum placements will be made in accord with students' backgrounds, experience, and progress in the program.

**DEPARTMENTAL DIRECTORY**

	<b>Office</b>	<b>Telephone Number</b>
Bureau of Field Services	118 CU	437-3298
Counselor Education	405 CU	437-3276
Curriculum and Instruction	227 CU	437-3302
Director of Field Placement	96 CA	437-3280
Educational Administration	82 CA	437-3286
Foundations of Education	306 CU	437-3282
Graduate School of Education	118 CU	437-2708
Rehabilitation Administration	6 RB	437-2485
Special Education	6 RB	437-2485
Speech Pathology and Audiology	133 FR	437-2493

**UNDERGRADUATE COLLEGES**

*Offering full-time day curricula on the Cooperative Plan leading to baccalaureate degrees*

Boston-Bouvé College	College of Liberal Arts
College of Business Administration	College of Nursing
college of Criminal Justice	College of Pharmacy and Allied Health Professions
College of Education	
College of Engineering	Lincoln College

*Offering part-time curricula during late afternoon and evening hours leading to associate and baccalaureate degrees*

Lincoln College  
University College

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## ACADEMIC CALENDAR 1976—1977

### Fall Quarter 1976

Registration period		
Burlington	Tuesday—Wednesday	Sept. 14—15
Boston	Monday—Thursday	Sept. 20—23
Classes begin	Monday	Sept. 27
Examination period	Monday—Saturday	Dec. 13—18

### Winter Quarter 1976—1977

Registration period		
Burlington	Tuesday	Nov. 30
Boston	Monday—Thursday	Dec. 6—9
Classes begin	Monday	Jan. 3
Examination period	Monday—Saturday	Mar. 21—26

### Spring Quarter 1977

Registration period		
Burlington	Tuesday	Mar. 8
Boston	Monday—Thursday	Mar. 14—17
Classes begin	Monday	Apr. 4
Last day to file card for		
Spring Commencement	Friday	Apr. 1
Last day to pay fee for		
Spring Commencement	Friday	Apr. 29
Final grades due in Registrar's		
Office for June graduates	Friday	June 3
Examination period	Monday—Saturday	June 13—18
Spring Commencement	Sunday	June 19

### Summer Quarter 1977

Registration period		
Burlington	Monday—Tuesday	June 13—14
Boston	Wednesday—Thursday	June 15—16
Classes begin	Monday	June 27
Last day to file card for		
Fall Commencement	Friday	July 1
Last day to pay fee for		
Fall Commencement	Monday	Aug. 1
Examination period	Wednesday—Thursday	Aug. 3—4

## **UNIVERSITY HOLIDAYS 1976—1977**

Columbus Day	Monday	October 11
Veterans' Day	Thursday	November 11
Thanksgiving Recess	Thursday—Saturday	November 25—27
Christmas Vacation	Monday—Saturday	Dec. 20—Jan. 1
Martin Luther King Day	Saturday	January 15
Washington's Birthday	Monday	February 21
Patriot's Day	Monday	April 18
Memorial Day	Monday	May 30
Independence Day	Monday	July 4
Labor Day	Monday	September 5

## **Equal Opportunity Policy**

Northeastern University is committed to a policy of providing equal opportunity for all. In all matters involving admissions, registration, and all official relationships with students, including evaluation of academic performance, the University insists on a policy of nondiscrimination. Northeastern University is also an equal opportunity employer; it is institutional policy that there shall not be any discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or on the basis of being a handicapped but otherwise qualified individual. In addition, Northeastern takes affirmative action in the recruitment of students and employees. Inquiries concerning our equal opportunity policies may be referred to the University Affirmative Action Officer and/or the Title IX coordinator.

## **Delivery of Services**

The University assumes no liability, and hereby expressly negates the same, for failure to provide or delay in providing educational or related services or facilities or for any other failure or delay in performance arising out of or due to causes beyond the reasonable control of the University, which causes include, without limitation, power failure, fire, strikes by University employees or others, damage by the elements and acts of public authorities. The University will, however, exert reasonable efforts, when in its judgment it is appropriate to do so, to provide comparable or substantially equivalent services, facilities or performance, but its inability or failure to do so shall not subject it to liability.

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# the university

Founded in 1898, Northeastern University is incorporated as a privately endowed nonsectarian institution of higher learning under the General Laws of Massachusetts. The State Legislature by special enactment has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of 180 distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration (1922); Liberal Arts (1935); Education (1953); Pharmacy (1962); Nursing (1964); Boston-Bouvé College (1964); the College of Criminal Justice (1967); and by Lincoln College's day Bachelor of Engineering Technology Programs (1971). This educational method enables students to gain valuable practical experience as an integral part of their college program and also provides the means by which they may contribute substantially to the financing of their education. The Plan has been extended to the graduate level in engineering, actuarial science, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. University College offers evening courses—offered by the University since 1906—and adult-day courses leading to the bachelor's degree. In addition to its day undergraduate programs in Electrical Engineering Technology and Mechanical Engineering Technology, Lincoln College offers evening/part-time certificate, associate, and bachelor degree programs in technological areas. All formal courses of study leading to degrees through part-time programs are approved by the Basic College faculties concerned.

## **GRADUATE AND PROFESSIONAL SCHOOLS**

The ten graduate and professional schools of the University offer day and evening programs leading to the degrees listed:

The Graduate School of Actuarial Science offers the degree of Master of Science in Actuarial Science.

The Graduate School of Arts and Sciences offers the degrees of Master of Arts, Master of Science, Master of Science in Health Science, Master of Public Administration, and Doctor of Philosophy.

The Graduate School of Boston-Bouvé College offers the degree of Master of Science, with specialization in Physical Education and Recreation Education.

The Graduate School of Business Administration offers the degree of Master of Business Administration.

The Graduate Program in Criminal Justice offers the degree of Master of Science.

The Graduate School of Education offers the degree of Master of Education and Doctor of Education and the Certificate of Advanced Graduate Study.

The Graduate School of Engineering offers the degrees of Master of Science, Engineer, Doctor of Philosophy, and Doctor of Engineering in Chemical Engineering.

The School of Law offers the degree of Juris Doctor.

The Graduate School of Pharmacy and Allied Health Professions offers the degrees of Master of Science and Doctor of Philosophy.

The Graduate School of Professional Accounting offers the degree of Master of Science in Accounting.

### **CENTER FOR CONTINUING EDUCATION**

The Center for Continuing Education was established to relate the University to the needs of its community in a period of accelerated change. Its programs are composed of seminars, conferences, institutes, forums, and a wide variety of special courses designed to serve specific needs. The Division of Special Programs, working cooperatively with trade associations and professional societies, offers a wide variety of programs dealing with current needs and problems. Through its Division of Community Services, working with governmental agencies and community organizations, the Center is becoming increasingly involved in social problems on both the local and national level.

Many of these programs are conducted at Henderson House, Northeastern University's conference center in Weston, Massachusetts.

### **RESEARCH ACTIVITIES**

The facilities of the University are engaged in a wide variety of basic research projects in business, science, social science, pharmacy, and engineering. These are coordinated by the Dean of Research, whose services are University-wide and available to the faculties of all the Colleges.

Although Northeastern is primarily concerned with undergraduate and graduate instruction, the University believes that the most effective teaching and learning take place in an environment characterized by research activities directed toward extending the frontiers of knowledge.

# **buildings and facilities**

## **MAIN CAMPUS**

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, the Boston Public Library, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intrastate lines, and MBTA subway-bus service within the metropolitan-suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of 48 acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Most are interconnected by underground passageways.

## **Libraries**

The University library system consists of the Dodge Library, which is the main library; the Suburban Campus Library at Burlington; the School of Law Library; and three divisional libraries for Physics and Electrical Engineering, Chemistry and Biology, and Mathematics and Psychology, Physical and Recreation Education, and Physical Therapy. There are additional subject collections for the Center of Management Development at Andover, Massachusetts, and the Marine Science Institute at Nahant.

The library collections number 400,000 volumes supplemented by some 333,000 titles in microprint, microfilm, and microfiche forms. The collection includes, in addition, some 3,700 periodical titles, 100,000 documents, and 4,600 sound recordings.

## **SUBURBAN FACILITIES**

### **Suburban Campus**

The Suburban Campus, located near the junction of Routes 128 and 3 in Burlington, Massachusetts, was established to meet the needs of individuals and of industry in the area.

In addition to graduate courses in engineering, business administration, science, education, and the arts, portions of undergraduate programs leading to the associate and bachelor's degrees, special programs for adults, and noncredit state-of-the-art programs are offered.

### **Marine Science Institute**

The Marine Science Institute at Nahant, Massachusetts, is a research and instructional facility primarily engaged in studies of marine biology and oceanography. The Institute is operated all year, and is about 20 miles northeast of Boston. Many of the courses at the institute are applicable toward an advanced degree in biology or health science.

### **Government Center Campus**

With the cooperation of the Federal Executive Board, the Department of Political Science offers an entire Master of Public Administration Program at the John F. Kennedy Building in downtown Boston. This program is primarily for individuals employed in federal, state, or local civil services.

### **Henderson House**

The University's conference center, Henderson House, is located in Weston, Massachusetts. The Center for Continuing Education conducts short-term courses, seminars, and special institutes for business, professional, and research groups. Henderson House is 12 miles from the main campus.



# the graduate school of arts and sciences

Thirty-five years ago the Department of Chemistry and the Department of Physics inaugurated the first graduate programs at Northeastern. In the succeeding years the creation of degree programs in other departments of the College of Liberal Arts led to the formation of the graduate program of arts and sciences in 1958 and finally the Graduate School of Arts and Sciences in 1963. Ten departments now offer work at the graduate level.

The Master of Arts degree may be earned in economics, English, history, political science, psychology, sociology, and social anthropology. The Master of Science degree is available in biology, chemistry, clinical chemistry, economic policy and planning, mathematics, and physics. The Master of Science in Health Science and the Master of Public Administration degrees are also offered. In addition, there are programs leading to the Doctor of Philosophy degree in biology, chemistry, economics, mathematics, physics, psychology, and sociology.

## GENERAL REGULATIONS

The general regulations of the graduate school that follow are minimal requirements shared by the several degree programs. The student is advised to consult the appropriate departmental section for a statement of specific requirements.

### Application

All applicants should address inquiries to the Director of the Graduate School of Arts and Sciences. Initial correspondence directed elsewhere may result in valuable time lost in initiating the admissions procedure. Application forms and reference blanks will be mailed to the applicant. This material, together with complete official transcripts, the Graduate Record Examination scores when required, and the results of the Test of English as a Foreign Language, required of all applicants whose native language is not English, should be returned to the Director of the Graduate School of Arts and Sciences. Applications for those desiring assistantships should be submitted no later than March 15; however, some departments have earlier deadlines. Applications received after this date may not be given equal consideration. All necessary supporting documents must be on file with the graduate school office at least four weeks before the date of registration for the quarter in which the student expects to begin his scholastic program. For more detailed information see departmental requirements for admission.

All applicants to the graduate school are strongly urged to take both the aptitude and advanced portions of the Graduate Record Examination. These tests are presently required in biology, English, history, mathematics, psychology, and sociology and anthropology. Applicants for the M.A. in Political Science are required to furnish scores only for the verbal and quantitative aptitude tests. At present the Graduate Record Examination is not required of M.P.A. applicants. At least two letters of recommendation are required of all candidates. In biology, physics, political science (M.A. and M.P.A.), psychology, and sociology and anthropology, three letters are necessary. Candidates for financial awards should so indicate to those supplying references.

Applications for the Graduate Record Examination can be obtained by writing to:

Educational Testing Service  
Box 955  
Princeton, New Jersey 08540

Applications for the Test of English as a Foreign Language can be obtained by writing to:

Educational Testing Service  
Box 899  
Princeton, New Jersey 08540

## **Admission**

To be enrolled for graduate work, an applicant must submit a complete official transcript indicating the award of a bachelor's degree from a recognized institution and provide evidence that he is able to pursue creditably a program of graduate study in his chosen field. His scholastic record must therefore show distinction, and his undergraduate program show breadth as well as adequate preparation in the field in which the applicant expects to do advanced work. Admission to the graduate school is for a specific academic quarter. Students who fail to attend must reapply if they wish to do course work in a subsequent quarter. Acceptance to the school is granted upon recommendation of the departmental graduate committee after a review of the completed application. Foreign students who do not receive a graduate award or whose award is insufficient to cover all educational and living expenses must certify that they are able to meet all their expenses while at Northeastern. A visa may not be granted without such certification.

## **Student Classifications**

*Regular Student* Those students admitted with a bachelor's degree showing a high quality of previous work.

*Provisional Student* Students whose records do not qualify them for enrollment as regular students. Provisional students must obtain a B

average in the first 12 quarter hours of study for continuation in the degree program.

**Special Student** Students not matriculated in a degree program. Acceptance as a special student is in no way related to admission into a departmental degree program. However, those special students subsequently admitted into a degree program may apply the first twelve quarter hours of credit earned as a special student toward degree requirements. Special students are expected to maintain a B average in the first 12 quarter hours of study.

**Doctoral Student** Students admitted to a doctoral program.

**Doctoral Degree Candidate** Doctoral students who have completed 40 quarter hours of acceptable graduate work and have passed the qualifying examination.

## **Registration**

Students must register within the dates and times listed on the school calendar. The place of registration will be announced prior to each period.

## **Residence**

All work for advanced degrees must be registered for and completed at the University unless approval has been obtained from the director of the graduate school for work taken elsewhere.

## **Programs of Study**

The study load for full-time students is usually four courses per quarter. Part-time students are limited to two courses per quarter unless permission to carry a heavier load is given by the departmental chairman or his designate. Courses in most fields are offered both in the afternoon and evening.

## **Grading System**

The performance of students in graduate courses will be recorded by the instructor by use of the following grades:

**A Excellent**

This grade is given to those students whose performance in the course has been of very high graduate caliber.

**B Satisfactory**

This grade is given to those students whose performance in the course has been at a satisfactory level.

**C Fair**

This grade is given to those students whose performance in the course is not at the level expected in graduate work.

**F Failure**

This grade is given to those students whose performance in the course is unsatisfactory.

*In addition, the following letter designations are used:*

**I Incomplete without quality designation.**

This grade may be given to those students who fail to complete the work of the course.

**L Audit without credit.**

**S Satisfactory without quality designation.**

**U Unsatisfactory without quality designation.**

An S or U grade is used for the first quarter of a two-quarter sequence in which the grade for the second quarter applies to both the first and second quarters of the sequence.

The I grade will be changed to a letter grade when the deficiency which led to the I is made up to the satisfaction of and in the manner prescribed by the instructor in the course, or, in his absence, by the chairman of the department in which the grade is given. The period for clearing such a grade will be restricted to one calendar year from the date of its first being recorded on the student's permanent record.

Students must indicate their preference for auditing a course at registration. No credit will be given for the course. It will, however, appear on the student's transcript. Registration changes from an audit to a graded status, or vice versa, may only be made prior to the first day of classes.

### **Class Hours and Credits**

All credits are entered as quarter hours. A quarter hour of credit is equivalent to three-fourths of a semester hour credit.

### **Continuity of Program**

Students are expected to maintain continuous progress toward a degree. Any student who does not attend Northeastern for a period of one year must apply for readmission.

### **Withdrawals**

In order to withdraw from a course, a student must fill out an official withdrawal form obtained at the Registrar's Office or at the Suburban Campus Office. Withdrawals may be made through the ninth week of the quarter. Students will be withdrawn as of the date on which they fill out the form. Ceasing to attend a class or notifying the instructor does not constitute an official withdrawal.

### **Changes In Requirements**

The continuing development of the graduate school forces frequent revision of curricula. In every new bulletin some improvements are indicated.

When no hardship is imposed on the student because of changes, and when the facilities of the school permit, the student is expected to meet the requirements of the last bulletin. If the student finds it impossible to meet these requirements, the bulletin for the year in which he entered becomes the binding one.

### **Application for the Diploma**

If a commencement card is not filed with the Registrar's Office on or before the applicable date listed in the calendar, there is no assurance that the degree will be granted in that particular year even though all other requirements have been fulfilled.

## **THE MASTER'S DEGREE**

### **Admission**

Specific requirements for each degree program will be found in the appropriate paragraphs for each department.

### **Academic Requirements**

A candidate for the master's degree must complete a minimum of 40 quarter hours of correlated work of graduate caliber and such other study as may be required by the department in which he is registered.

During the first half of the total number of hours of course work required for the degree, the candidate will be expected to maintain a minimum quality point average of 2.5. At the completion of three-fourths of the total number of hours of course work required for the degree, the candidate will be expected to have a quality point average of 2.8. To qualify for the degree, a final average of 3.0, equivalent to a grade of B, must be obtained. This average will be calculated quarterly by the graduate school on the basis of A=4, B=3, C=2, and F=0 and will exclude any transfer credits.

Not more than six quarter hours of repeated courses, additional courses, or permanent I's may be allowed in order to satisfy the requirements for the degree.

Within the above limitations, a required course for which a grade of F is received must be repeated with a grade of C or better, and may be repeated only once. If a grade of F is received in an elective course, that course may be repeated once to obtain a grade of C or better, or another elective course may be substituted for it. If a grade of C is received in a required course, that course may be repeated once to obtain a grade of B or better.

### **Comprehensive Examination**

A final written or oral comprehensive examination may be required. This

examination will be given at least two weeks before the commencement at which the degree is expected.

### **Thesis**

A thesis must show independent work based on original material, be approved by the department graduate committee, and in cases where a department requires a grade, must receive a grade of B or better to be accepted.

### **Language Requirement**

An examination to show evidence of ability in one or more foreign languages is required in some graduate programs. This knowledge is established by an examination which will be administered by the graduate school at least twice yearly.

### **Transfer Credit**

A maximum of 12 quarter hours of credit obtained at another institution may be accepted toward the master's degree provided that the credits transferred consist of A or B grades in graduate level courses, be in the candidate's field, have been earned at a recognized institution, and have not been used toward any other degree. Students should petition the director of the graduate school in writing for all transfer credit. Transfer credit grades may not be used for the purpose of obtaining the academic average necessary for the completion of the degree requirements.

### **Time Limitation**

Course credits earned in the program of graduate study, or accepted by transfer, are valid for a maximum of seven years unless an extension is granted by the Committee of the Graduate School of Arts and Sciences.

## **THE DOCTOR OF PHILOSOPHY DEGREE**

The Doctor of Philosophy degree is awarded to candidates who give evidence of high attainment and research ability in their major field. The degree requirements are administered by committees in charge of each degree program. These committees may be departmental graduate committees or the committee of the graduate school depending upon the nature of the program. It is the responsibility of the chairman of the committee to certify to the Graduate School Office the completion of each requirement for each candidate.

### **Admission**

Each degree program has an established admission procedure for students starting their doctoral work at Northeastern University.

**Residence Requirement**

Candidates for the Doctor of Philosophy degree must spend the equivalent of at least one academic year in residence at the University as a full-time graduate student. The committee of each degree program specifies the method by which the residence requirement is satisfied.

**Qualifying Examination**

Students must pass a qualifying examination within time limits set by the committee of each degree program.

**Comprehensive Examination**

Degree programs may require a comprehensive examination during the time in which a student is a degree candidate.

**Course Requirements**

The minimum course requirement of 40 quarter hours constitutes the work normally required for a master's degree. The course requirements beyond this in each doctoral program are specified by the committee in charge of the doctoral program.

**Dissertation**

Each doctoral student must complete a dissertation which embodies the results of extended research and makes an original contribution to the field. This work should give evidence of the candidate's ability to carry out independent investigation and interpret in a logical manner the results of the research. The method of approval of the dissertation is established by the committee in charge of the degree program.

**Language Requirement**

The foreign language requirement is established by the committee in charge of each degree program.

**Final Oral Examination**

The final oral examination will be on the subject matter of the doctoral dissertation and significant developments in the field of the dissertation. Other fields may be included if recommended by the examining committee.

This examination will be taken after completion of all other requirements of the degree and must be held at least two weeks prior to the commencement at which the degree is to be awarded.

**Transfer Credit**

Approval for transfer credit may be given by the committee in charge of the degree program.

### **Time Limitation**

After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements.

### **Registration**

All students must register for course work or dissertation as approved by their advisers or the departmental registration officer. After the first registration for doctoral work, registration must be continuous unless withdrawal is allowed by the committee in charge of the degree program. Students must be registered for dissertation during the quarter in which they take the final oral examination.

## **INTERDISCIPLINARY PROGRAMS**

Some graduate students may wish to pursue doctoral programs which involve substantial work in two or more departments. To meet this need, an interdisciplinary program may be established which corresponds in scope and depth to doctoral standards, but does not agree exactly with the individual departmental regulations. For such possibilities, the following option is available:

### **Admission**

Application for admission to interdisciplinary doctoral study consists of the submission of a carefully thought-out written proposal describing the areas of proposed study and research. The proposal may be a part of the initial application for admission to graduate study at Northeastern University, or it may be submitted by a student already enrolled. It may be directed to a doctoral degree-granting department or to the director of the graduate school who forwards it to the appropriate department. In either case, admission to interdisciplinary doctoral study requires favorable recommendation by the sponsoring doctoral degree-granting department and approval by authorized representatives of the graduate study committees of the departments appropriate to the disciplines covered by the applicant's proposal. The sponsoring department becomes the registration base of the student.

### **Formation of Interdisciplinary Committee**

A student who has been accepted for interdisciplinary study must obtain the consent of an adviser who will direct his doctoral dissertation. This adviser, who may or may not be a member of the registration department, will be chairman of the interdisciplinary committee for this student. A second member will be appointed from the registration department by its chairman. These two members will obtain one or more additional members or request the director of the graduate school to do so. At least two departments must be represented on the committee and a majority of the



committee must come from doctoral degree-granting departments. The chairman of the registration department will notify the director of the graduate school of the membership of the committees as soon as arrangements are complete.

### **Duties of Interdisciplinary Committee**

A member of the interdisciplinary committee who is also a member of the registration department will serve as the registration officer to approve the course registration for the student. A copy of the approved course registration must also be filed with the other committee members and with the graduate study committee of the registration department.

The interdisciplinary committee will be responsible for the administration of the qualifying examination, language examination, approval of the dissertation, and comprehensive examination. This committee must also certify to the registration department the completion of the requirements for the award of the doctoral degree.

The interdisciplinary committee must assure that the program of the student represents standards comparable to those of the registration department and that the program is not so broad that it has inadequate depth in any area.

The program of the student may be reviewed at any time by the director of the graduate school to determine whether objectives of the program are being met.

# financial information

## FINANCIAL OBLIGATIONS

### Tuition

#### *Master's Degree Candidates*

The tuition rate for 1976 - 1977 is \$67 per quarter hour of credit.

#### *Doctoral Candidates*

Tuition for full-time doctoral candidates in 1976 - 1977 is \$67 per quarter hour of credit. Doctoral candidates actively utilizing the resources of the University in their Ph.D. dissertation are charged an additional \$600 per quarter. Those doctoral candidates registered for dissertation work performed off campus are charged \$200 in addition to tuition charges each quarter, and those doctoral candidates who are no longer actively utilizing University resources are charged a continuation fee of \$50 per quarter.

Tuition statements are mailed to students by the Bursar's Office and are payable by check to Northeastern University.

### Fees

An application fee of \$15 is charged all students when they apply for the first time in the graduate school at Northeastern.

Other fees include a charge of \$10 for late payment of tuition; a fee of \$25 for all degree candidates, payable before commencement by the applicable date listed on the academic calendar.

For full-time students there is a charge of \$12.50 per quarter for the services available in the Student Center. The fee for teaching assistants and research fellows is \$6.25 each quarter. All part-time students on the Huntington Avenue campus are charged \$.75 a quarter.

All full-time students will pay a nonrefundable University health services fee of \$120 each year. This fee will provide Blue Cross-Blue Shield coverage and entitle the student to the medical care furnished by the University Health Services. Tuition and fees are subject to change without notice.

All financial obligations to the University must be discharged by graduation.

Tuition rates and fees are subject to revision by the Board of Trustees at any time.

### Refunds

Tuition refunds will be granted only on the basis of the date appearing on the official withdrawal form filed by the student. Nonattendance does not

constitute official withdrawal. Questions regarding refunds should be discussed with the Bursar's Office.

Refunds will be granted in accordance with the following schedule:

Amount of Refund	
Official Withdrawal Filed Within	Percentage of Tuition
First week of quarter	100
Second week of quarter	75
Third week of quarter	50
Fourth week of quarter	25

## **FINANCIAL AID**

Northeastern University has available fellowships and assistantships for full-time students who are working toward the master's or doctor's degree. Candidacy for these awards may be established by completing the relevant section of the application for admission. Those students already enrolled should consult their departmental adviser.

### **Teaching Assistantships**

Teaching assistantships allowing remission of tuition and a stipend are available in all departments. Holders of such awards devote half time to academic assistance directly related to the teaching function and the balance to course work.

### **Graduate Administrative Assistantships**

Some University departments offer the graduate student an opportunity for remission of tuition and a stipend in return for half time spent in assisting with nonteaching, administrative duties.

### **Tuition Assistantships**

Many departments provide remission of tuition to full-time students assisting eight hours a week in the administrative work of the department. These awards are normally given to students in the first year of graduate work.

### **Research Fellowships**

A number of departments offer research fellowships including N.I.H., N.S.F., and N.D.E.A. carrying a stipend and remitting tuition. Certain of these grants require half-time work on research in the department, with the remaining time devoted to course work. Others provide for full-time work on research used for a thesis or dissertation.

### **Martin Luther King, Jr., Scholarships**

A limited number of full- and part-time Martin Luther King, Jr., Fellowships are available. These scholarships provide for remission of tuition.

tion and all fees, and are awarded to qualified black students on the basis of financial need. Additional information and application forms are available from the Office of Financial Aid.

### **Robert A. Feer Scholarship**

This scholarship is awarded yearly to the outstanding candidate for the Master of Arts degree in History. The scholarship was established in memory of Professor Robert A. Feer who was a member of the Department of History from 1963 to 1970.

### **Appointments**

Appointments to fellowships and assistantships are ordinarily announced no later than April 15 for the following academic year or summer. Appointments are for a maximum of three quarters and are not automatically renewed. Students who hold assistantships and research fellowships are expected to devote full time to their studies and the duties of the award. They may not accept outside employment without the consent of their faculty adviser and the director of the graduate school.

### **Acceptance Conditions**

Northeastern University, which is a member of the Council of Graduate Schools of the United States, subscribes to the following resolution of the Council:

Acceptance of an offer of financial aid (such as a graduate scholarship, fellowship, traineeship, or assistantship) for the next academic year by an actual or prospective graduate student completes an agreement which both student and graduate school expect to honor. In those instances in which the student accepts the offer before April 15 and subsequently desires to withdraw, the student may submit in writing a resignation of the appointment at any time through April 15. However, an acceptance given or left in force after April 15 commits the student not to accept another offer without first obtaining a written release from the institution to which a commitment has been made. Similarly, an offer by an institution after April 15 is conditional on presentation by the student of the written release from any previously accepted offer.

### **Dormitory Proctorships**

A number of proctorships for men in dormitories on or near the Huntington Avenue campus are available each year. Appointments carry a minimum compensation of room and board. Further information and application forms may be obtained from the Office of University Housing.

### **National Direct Student Loan**

This program is available to students who are carrying at least one-half

the normal academic work load, are accepted as degree candidates, and who show evidence of financial need.

The Federal maximum which a graduate student may borrow while pursuing a post-baccalaureate degree is \$5,000.

Repayment and interest on these loans do not begin until nine months after the student ceases to carry at least a half-time academic load at an institution of higher education. The repayment of principal may be extended over a 10-year period with the interest at the rate of three percent per annum. Repayment may be deferred up to a total of three years while a borrower is serving as a Peace Corps or VISTA volunteer.

### **Guaranteed Student Loan Program**

Under this program, students who are matriculated degree candidates, enrolled for at least one-half the normal academic work load, may borrow from a participating bank or other financial institution. Terms and conditions vary from state to state, but a student generally may borrow up to \$1,500 a year (the law allows a maximum of \$2,500 per year) depending on financial need. The Federal government pays the interest while the student is in school if the student is eligible for interest subsidy.

The student must have submitted, through the College Scholarship Service, a Parents' Confidential Statement; or if he has been declared financially independent by the Financial Aid Office, a Students' Confidential Statement. These forms are available from local banks or the Education Office of your state government. Additional information and necessary application forms for Massachusetts residents are available from the Financial Aid Office.

**The federal aid programs listed above are available to citizens and permanent residents of the United States.**

## **fields of study**

*The departmental sections that follow list courses available to a student during the typical period of attendance required to obtain a degree. The quarter in which a specific course will be offered will be found in the course announcement made available in May for the summer quarter and in June for the following academic year.*

# biology

## **Professors**

Francis D. Crisley, Ph.D.  
Janis Z. Gabliks, D.D.S., Ph.D.  
Charles Gainor, Ph.D.  
Abdul-Karim Khudairi, Ph.D.  
Nathan W. Riser, Ph.D., Director,  
Marine Science Institute

## **Associate Professors**

Charles H. Ellis, Jr., Ph.D.  
Helen Lambert, Ph.D.  
Charles A. Meszoely, Ph.D.  
M. Patricia Morse, Ph.D.  
Joseph V. Pearincott, Ph.D.  
Fred A. Rosenberg, Ph.D.  
Ernest Ruber, Ph.D.  
Henry O. Werntz, Ph.D., Chairman

## **Assistant Professors**

William Hartner, Ph.D.  
Dale F. Levering, Jr., Ph.D.  
Daniel Scheirer, Ph.D.  
Phyllis R. Strauss, Ph.D.

## **THE MASTER OF SCIENCE DEGREE**

### **Full-Time Program**

## **THE MASTER OF SCIENCE IN HEALTH SCIENCE DEGREE**

### **Part-Time Program**

## **Admission**

In addition to the requirements listed on page 22 applicants should have a background which includes one year each of organic chemistry, physics and mathematics, and the six quarter courses of the biology undergraduate core curriculum or their equivalents. Students admitted with deficiencies should remove them during the first 20 quarter hours of graduate work.

## **Program**

Forty-six quarter hours of academic work are required. A candidate for either degree is expected to take forty hours of course work including four hours of seminar. Transfer credits will be accepted only from those schools offering graduate programs in biology. Application for such credit should be made in writing to the Graduate Director of the respective program during the first quarter following the student's assignment to an academic adviser. Other limitations on transfer credit are listed on page 27. Graduate courses in departments other than Biology will be accepted for credit up to a limit of 12 quarter hours, including those credits previously accepted as transfer credits, upon written recommendation from the student's adviser to

the graduate director for final approval.

During his tenure, in addition to the above course requirements, each student pursuing work toward the master of science in Biology must enroll for a minimum of six credits of work in 18.990, Special Topics in Biology, or 18.991, Research for the Master of Science degree. After initial election of either 18.990 or 18.991 the student must register for either of these courses for each quarter until the work is completed. Work in 18.990, Special Topics in Biology, is pursued under the supervision of an individual faculty member, by mutual agreement. It may take the form of a comprehensive, critical review of the literature in a specialized area and/or a specific program of experimental work on a single topic. If experimental work has been elected under 18.990 it may later be expanded, with permission of the department graduate committee, into a master's thesis with a topic and adviser and a committee of three members approved by the departmental graduate committee. Grades in 18.990 or 18.991 are recorded as "Satisfactory" (or "Unsatisfactory") until all work is completed, culminating in either a comprehensive, well-written report — which must be reviewed by the department graduate committee — or a thesis. For the latter a final oral examination on the thesis is required. The department encourages the pursuit of a thesis wherever feasible.

The program leading to the Master of Science in Health Science degree is designed for part-time students who may progress according to their abilities, the time available, and the need or desire to extend their education into interdisciplinary work involving biology or allied areas such as the health sciences. Students may elect to substitute six quarter hours of course work credit for the required 18.990, Special Topics in Biology or 18.991, M.S. Thesis. Those students electing the course option must take a comprehensive examination in the last six-month period of their program, similar to that required of non-thesis students in the M.S. in Biology degree. If their schedules permit, students in the M.S. in Health Science program may carry out their work on a full-time basis.

## **THE DOCTOR OF PHILOSOPHY PROGRAM**

### **Admission**

Applicants who will have a master's degree or its equivalent at entry may be considered for direct admission to the doctoral program. Those who will not may be considered only after admission to the master's program, and, after satisfactory completion of 30 quarter hours of graduate study, may then be considered for admission to the doctoral program. In addition, a student must present evidence of the willingness of a faculty member of the graduate faculty to serve as the Ph.D. thesis adviser.

### **Residence Requirement**

After admittance to the doctoral program, the student may satisfy the residence requirement by one year of full-time graduate work or by two

years of half-time graduate work. However, a student should expect to spend at least two years or the equivalent in full-time study.

### **Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations.

### **Qualifying Examination**

Students entering the doctoral program will be expected to have had the equivalent of an M.S. degree at Northeastern before taking their qualifying examination. Students who have been accepted into the doctoral program must take their qualifying examination by the end of three quarters at Northeastern University. The student will be expected to demonstrate an advanced knowledge of biological concepts. The examination will be oral, given by a standing committee, and last approximately two hours. Eligibility to continue in the program toward the Doctor of Philosophy degree is contingent upon satisfactory performance on the qualifying examination.

### **Comprehensive Examination**

The comprehensive examination requirement will be fulfilled by two written examinations, one in the major area of specialization and the other in closely related areas. The candidate may apply through his adviser after completing the foreign language requirement and at least one quarter prior to the oral examination.

### **Course Requirements**

After the establishment of candidacy, any further course requirements will be established by the dissertation adviser and approved by the departmental graduate committee.

### **Dissertation**

Arrangements for a dissertation adviser are made at the time of admittance into the Ph.D. program. Research for the Ph.D. is performed under the guidance of the dissertation adviser. The adviser also serves as the chairperson of the doctoral committee which must consist of at least 5 members. The research proposal and the doctoral committee must be approved by the Department Graduate Committee. The doctoral committee must approve the dissertation before the degree may be conferred.

### **Language Requirement**

Ability to read and translate biological literature in one foreign language must be established by the candidate. In order to maximize the usefulness of this language as a tool of research, the student should take the language



examination as early as possible. The examination will be administered by the Department of Biology, or in certain cases, by the Modern Language Department. French, German, and Russian are the three most important foreign languages for the biologist. Students will be expected to choose one of these languages for their examination, but another language may be substituted where there is significant literature in the area of interest.

### **Tool of Research**

A tool of research is required in addition to the above language. This requirement may be fulfilled through either passing a second foreign language examination in a language in which there is significant literature, or completion of a program in the general principles of statistics, biometry, and/or computer programming.

### **Final Oral Examination**

This examination will be held in accordance with the general regulations of the graduate school.

## **INTERDISCIPLINARY PROGRAMS**

### **Admission**

Application and credentials for admission to interdisciplinary programs involving the Biology Department, where this department is clearly the department of registry, as described under "General Regulations," should be submitted as described under the heading of "Admission" in the section "The Doctor of Philosophy Program" for biology. The interdisciplinary committee will consist of at least five members. The composition of this committee will be determined by mutual consent between the departments involved, but will have at least three members from the Biology Department if the dissertation adviser is from this department. Upon admission, suitable interdisciplinary course requirements will be determined by the interdisciplinary committee.

### **Qualifying Examination**

Students accepted into the program will normally be expected to complete the qualifying examination by the end of three quarters at Northeastern University. At least five areas of study will be covered by the qualifying examination, at least three of which will be oral examinations chosen by the candidate from the following areas: biochemistry, botany, ecology, genetics, microbiology, physiology, and zoology. The remaining components of the examination will be specified and evaluated by the other participating department. With the exceptions of the procedures for admission and examinations for qualification, the remaining requirements and procedures are as specified under "The Doctor of Philosophy Program" for biology.

## DESCRIPTION OF COURSES

### **18.804 Lower Invertebrates** (4 q.h.)

Taxonomy, morphology, embryology, and life histories of acoelomate phyla (Marine Science Institute).

### **18.805 Coelomate Invertebrates** (4 q.h.)

Biology of annelids, arthropods, molluscs and echinoderms (Marine Science Institute).

### **18.806 Malacology** (4 q.h.)

Functional morphology, embryology, systematics, and ecology of the major groups of molluscs. *Prep. Invertebrate Zoology.*

### **18.809 Mammalogy** (5 q.h.)

Phylogeny, anatomy, physiology, behavior, reproduction, population dynamics, and natural history of the mammals. The course will include student presentation of the recent advances in mammalogy. Field collection and laboratory preparation and study of specimens will be included. *Prep. Comparative Anatomy of Embryology.*

### **18.810 Ichthyology** (4 q.h.)

Natural history and systematics of fishes, with emphasis on marine species (Marine Science Institute). *Prep. Comparative Anatomy or Vertebrate Zoology.*

### **18.813 Dynamics of Aquatic Ecology I** (3 q.h.)

Chemical, physical and biotic features influencing coastal, lake and stream communities. Lectures. *Prep. 18.134 or 18.834 or equivalent.*

### **18.814 Dynamics of Aquatic Ecology II** (3 q.h.)

One hour of lecture and one full day (7 hours) of laboratory-field work. *Prep. 18.813.*

### **18.818 Ecology of Salt Marshes** (3 q.h.)

Survey of fauna and flora, environmental factors affecting them and current biological and social problems associated with this habitat. This course will meet for 2 lectures of 1½ hours each and 1 full day of laboratory for 6 weeks during the summer quarter. *Prep. 18.134 or 18.834 or equivalent.*

### **18.819 Principles of Systematics** (3 q.h.)

Codes of nomenclature. Biological principles basic to methodology of the preparation of monographs and of faunas and floras.

### **18.823 Human Ecology** (4 q.h.)

Parameters of the human ecological niche, man's effect on them, and their consequences for him.

### **18.825 Plant Nutrition and Metabolism** (4 q.h.)

Mineral nutrition, photosynthesis, metabolic pathways, and translocation in higher plants.

### **18.826 Plant Growth and Reproduction** (4 q.h.)

Plant hormones, growth, development, and physiology of reproduction. *Prep. 18.825.*

**18.827 Physiology of Plant Growth and Development (2 q.h.)**

A general coverage of the internal and environmental factors that influence the physiology of plant growth and development. The mechanisms by which plant growth hormones regulate the physiology of plants will be discussed with particular emphasis on the roles of auxins, gibberellins, cytokinins, and phytochrome. *Alternates yearly with 18.833.*

**18.830 Marine Algae (4 q.h.)**

Systematics, life histories, and ecology of marine algae, with emphasis on the flora of the Gulf of Maine (Marine Science Institute).

**18.831 Plant Morphogenesis (4 q.h.)**

The origin of form, experimentally controlled development, and external and internal factors that govern development of form. Plant tissue, organ, and cell culture techniques employed in the study of morphogenetic processes. *Prep. 18.237.*

**18.833 Photosynthesis (2 q.h.)**

A general discussion of the biochemistry and physiology of photosynthesis with particular emphasis on recent discoveries in electron transport, chloroplast structure, and CO<sub>2</sub> assimilation. The evolution and requirements of photosynthesis will also be discussed. *Prep. 18.827. Alternates yearly with 18.827.*

**18.834 Environmental and Population Biology (2 q.h.)**

Physico-chemical factors influencing and influenced by organisms. Interactions among individual organisms and among species. Students will participate in lectures and laboratories given for 18.134. Individual work on specialized aspects of ecology will be assigned. *Prep. One year of General Biology, including plant and animal biology. Open only to graduate students completing deficiencies in entrance requirements.*

**18.835 Genetics and Developmental Biology (2 q.h.)**

Elaboration of the classic laws of heredity. Cytogenetics. Chemical basis of heredity. Selected examples of the development of form and function. Students will participate in lectures and laboratories given for 18.135 and will be assigned extra individual work. *Prep. General Biology. Open only to graduate students completing deficiencies in entrance requirements.*

**18.836 Cardiovascular Physiology (3 q.h.)**

Physiology of blood cells, anemia, polycythemia immunity and allergy. Electrophysiology of the heart, cardiac cycle, EKG, hemodynamics, capillary dynamics, pulmonary circulation, cardiovascular reflexes, cardiac output and venous return. Cardiac failure, coronary circulation, atherosclerosis, hypertension, cerebral circulation, circulatory shock.

**18.837 Cardiovascular Physiology Laboratory (1 q.h.)**

Three hours of laboratory study per week. *Prep. 18.836.*

**18.838 Animal Nutrition (2 q.h.)**

Detailed consideration of organic and inorganic nutritional requirements of man and selected animals. Digestion, absorption, and metabolism of nutrient materials. Role of vitamins, minerals, and trace elements in metabolism. Variation in nutritional

needs among normal individuals and in various physiologic and genetic pathologies. Evaluation of food additives and of permissible levels of toxic materials in food.

**18.840 Comparative Physiology of Regulatory Mechanisms** (2 q.h.)

Principles and selected examples of physiological response to environmental variation. *Prep. Basic Physiology.*

**18.842 Vertebrate Endocrinology** (2 q.h.)

Principles of hormonal regulation of physiological processes in vertebrates, mechanisms of hormone action, neuro-endocrine relationships. *Prep. Physiology.*

**18.845 Physiological Ecology** (2 q.h.)

Study of biological and chemical mechanisms involved in adaptation; homeostasis and its regulation, salt and water metabolism; respiratory and circulatory control systems; adaptation versus acclimation. Control systems within the body versus set points. *Prep. College Biology, Organic Chemistry.*

**18.847 Environmental Law** (2 q.h.)

The kinds of scientific information required for implementation of the legal and political aspects of environmental management. The role of the scientist as an expert witness. Scientific and legal predictability. Analyses of suitable dynamic models and case law with the goal of improving the results of legal, political, and scientific decisions bearing upon remedial environmental management. *Prep. Biology core and first course in physiology, e.g., 18.158 and 18.159.*

**18.852 Advanced Developmental Biology** (3 q.h.)

Analysis of development at the biochemical and cellular levels. Nucleic acid and protein synthesis, gene action and differentiation, cell-cell interactions, mechanisms of animal morphogenesis. 3 hrs. of lecture. *Prep. 18.135, 18.136 or consent of the instructor.*

**18.853 Advanced Developmental Biology Laboratory** (2 q.h.)

Analysis of the fundamental problems of development through experimental techniques. Culture of vertebrate and invertebrate embryos; microsurgical analysis of morphogenesis; biochemistry of development, cell-cell interactions; organ and tissue culture will be studied. 5 hours of laboratory per week. *Prep. 18.852 or consent of the instructor.*

**18.857 Advanced Mammalian Physiology** (4 q.h.)

Intensive study of the circulatory, respiratory, digestive, excretory, reproductive, nervous and endocrine systems in mammals, with emphasis on laboratory procedures and surgical techniques used with living animals — chiefly, the rat. *Prep. Background in Physiology, consent of the instructor.*

**18.860 Cell Biophysics and Biochemistry I** (5 q.h.)

Biogenesis and ultrastructure of the cell considered together with the biophysical procedures and biochemical patterns used in the study of cellular and tissue components. Lecture only. *Prep. Organic Chemistry, General Biology, Biochemistry and Cell Biology.*

**18.861 Cell Biophysics and Biochemistry II** (5 q.h.)

Laboratory portion of the course, 18.860. *Prep. Consent of the instructor.*

**18.903 Environmental Microbiology** (4 q.h.)

The microbial environment and ecology of the cell. Interactions between microbial populations, stressing soil and fresh-water associations. *Prep. 18.220 or equivalent.*

**18.907 Food Microbiology** (2 q.h.)

Microbiology of food with emphasis on the pathogenic types and their interactions with other groups indigenous to food. *Prep. 18.220 or equivalent.*

**18.908 Food Microbiology Laboratory** (2 q.h.)

Detection, quantification, and isolation of microorganisms and their products of significance in food with emphasis on the pathogenic types. *Prep. 18.907 (may be taken concurrently).*

**18.909 Animal Virology** (4 q.h.)

Physical and chemical properties of viruses. Viruses as intracellular parasites. Viral replication and genetics, host-virus interaction, pathogenesis, diseases, tumor viruses, and serological reactions. Laboratory sessions will consist of demonstrations emphasizing use of animals, eggs and animal cell cultures for cultivation, isolation, and identification of viruses. *Prep. 18.220 and 18.242 or their equivalent and Biochemistry.*

**18.910 Microbial Genetics** (3 q.h.)

Principles of bacterial and bacteriophage genetics. Nature of variation and inheritance and the mechanisms of exchange of genetic material. *Prep. 18.220 or equivalent.*

**18.911 Microbial Genetics Laboratory** (2 q.h.)

Origin, isolation, and characterization of mutants. Mechanisms of genetic exchange in bacteria and bacteriophage. *Prep. 18.910 (may be taken concurrently).*

**18.914 Medical Mycology** (2 q.h.)

Morphological, pathological, and epidemiological factors of pathogenic opportunistic and common fungal contaminants from human sources. *Prep. 18.220 and 18.224 or equivalents.*

**18.915 Medical Mycology Laboratory** (2 q.h.)

Basic methodology for demonstration and isolation of fungi in clinical specimens. Identification on morphologic and biochemical basis. *Prep. or co-requisite 18.914.*

**18.920 Industrial Microbiology** (3 q.h.)

Microorganisms and methods employed in production of products of economic and medical importance, decomposition of wastes, and control of desirable and unwanted processes and biodeterioration. Fermentation processes emphasized. *Prep. 18.240 or equivalent or consent of instructor.*

**18.921 Industrial Microbiology Laboratory** (2 q.h.)

Laboratory and discussion seminar sessions devoted to the study of selected commercial processes.

**18.936 Cell Biology** (2 q.h.)

Basic chemical and physical processes of cells related to their fine structure; oxidative and intermediary metabolism; photosynthesis, membrane phenomena; movement; chemical and physical processes of prokaryotic and eukaryotic cells. Students will participate in lectures and laboratories given for 18.136. Extra individual work will be assigned. *Prep. General Biology, college physics, and organic chemistry. Only open to graduate students completing deficiencies in entrance requirements.*

**18.940 Microbial Biochemistry** (4 q.h.)

Study of the enzymatic reactions, intermediate products, and metabolic pathways involved in carbohydrate, protein, and nucleic acid metabolism by microorganisms. *Prep. 18.220 and 18.240 or equivalents, and Biochemistry.*

**18.980 Seminar** (1 q.h.)

Various topics and newer developments in botany, microbiology, physiology, and zoology covered in depth. Student presentations are emphasized.

**18.990 Special Topics In Biology** (credit variable)

Special study of a selected topic under direction of a faculty member. Topic and direction of study to be arranged with the faculty member supervising the study.

**18.991 M.S. Thesis** (credit variable)

Research methods of some special field and their application to a specific problem, under direction of a faculty member.

**18.992 Special Investigations In Biology** (credit variable)

Laboratory studies on a topic not directly related to research being pursued for a thesis or dissertation.

**18.993 Biological Electron Microscopy** (4 q.h.)

Techniques of electron microscopy applied to biological materials. Specimen preparation, fixation, thin-sectioning, staining, operation of electron microscope, photographic techniques, interpretation of electron micrographs. Student seminars and project required. *Prep. Consent of the instructor.*

**18.995 Ph.D. Dissertation**

Original research in depth, representing a significant contribution of new biological knowledge, and a written dissertation thereon, under the supervision of a faculty member.

**90.821 Biochemistry I** (2 q.h.)

Discussion of the structures and chemistries of carbohydrates, proteins, lipids, nucleic acids, and selected cofactors. *Prep. One year Organic Chemistry.*

**90.822 Biochemistry II** (2 q.h.)

Bioenergetics, enzymes and enzyme kinetics, intermediary metabolism, including carbohydrate catabolism, tricarboxylic acid cycle, electron transport, and oxidative phosphorylation. *Prep. Biochemistry I (90.821).*

**90.823 Biochemistry III** (2 q.h.)

Continuation of intermediary metabolism from Biochemistry II, or 73.842, including

lipid, protein, and nucleic acid metabolism, photosynthesis, and cell regulation. *Prep. Biochemistry II (90.822).*

The following courses have been reviewed by the Biology Department Graduate Committee and may be taken for graduate credit. No more than twelve hours of courses outside of the 18.000 and Biochemistry courses may count toward the Master of Science degree in Biology or the Master of Science degree in Health Sciences.

**73.814 Concepts in Pharmacology I (2 q.h.)**

Selected areas of pharmacology are examined in depth with special reference to interactions of drugs and other chemical agents with biological systems. Emphasis is placed on biochemical mechanisms, experimental design, evaluation of data utilizing conventional statistical procedures, and techniques employed in pharmacological evaluations. Alternates yearly with 73.816.

**73.815 Concepts in Pharmacology II (2 q.h.)**

Continuation of 73.814.

**73.816 Concepts in Toxicology I (2 q.h.)**

Concepts of modern toxicology in which emphasis is placed on biochemical mechanisms underlying the toxicological action of drugs and other chemical substances upon biological systems. Selected topics in toxicology, including acute, sub-acute, and chronic effects of drugs in the experimental animal. Consideration of the predictive value of animal studies for drug effects in man. Alternates yearly with 73.814.

**73.817 Concepts in Toxicology II (2 q.h.)**

Continuation of 73.816.

**01.952 Industrial Hygiene (2 q.h.)**

Factors in the industrial environment that adversely affect the health, comfort, and efficiency of the worker. Industrial surveys, and application of engineering principles to control of dust, toxic metals, gases and vapors, organic compounds, radiation, pressure, temperature, and humidity.

**01.957 Air Pollution Science (2 q.h.)**

Theory and practice related to engineering management of air resources, control of gaseous emission, investigation and study of air pollution, sampling and analysis methods.

**11.872 Radiation Biology and Health Physics (2 q.h.)**

*Prep. consent of the instructor.*

*All undergraduate biology courses in the series designated 18.200-18.300 are available for graduate credit. Please consult the undergraduate or other appropriate bulletin for course details.*

**18.208 Comparative Vertebrate Anatomy**

5 q.h.

**18.209 Developmental Anatomy**

5 q.h.

**18.210 Invertebrate Zoology**

5 q.h.

18.211	Parasitology	4 q.h.
18.212	Vertebrate Paleontology	4 q.h.
18.220	General Microbiology	5 q.h.
18.227	Animal Histology	4 q.h.
18.228	Histological Technique	3 q.h.
18.231	Lower Plants	4 q.h.
18.232	Higher Plants	4 q.h.
18.234	Plant Anatomy	4 q.h.
18.235	Economic Botany	4 q.h.
18.236	Horticulture	4 q.h.
18.237	Introduction to Plant Physiology	5 q.h.
18.238	Local Flora	4 q.h.
18.239	Terrestrial Ecosystems of North America	4 q.h.
18.240	Microbial Physiology	4 q.h.
18.242	Medical Microbiology	4 q.h.
18.245	Serology-Immunology	3 q.h.
18.246	Serology-Immunology Laboratory	2 q.h.
18.248	Marine and Freshwater Microbiology Laboratory	2 q.h.
18.249	Marine and Freshwater Microbiology	2 q.h.
18.251	Comparative Animal Physiology	4 q.h.
18.252	Vertebrate Physiology I	3 q.h.
18.253	Vertebrate Physiology II	3 q.h.



# chemistry

## Professors

Karl Weiss, Ph.D.  
Chairman  
Bill C. Giessen, Dr. Sc. Nat.  
Barry L. Karger, Ph.D.  
Albert H. Soloway, Ph.D.  
Alfred Viola, Ph.D.

## Associate Professors

David M. Howell, Ph.D.  
Conrad M. Jankowski, Ph.D.  
Elmer E. Jones, Ph.D.  
Philip W. LeQuesne, Ph.D.  
John L. Roebber, Ph.D., Executive Officer  
Robert N. Wiener, Ph.D.

## Assistant Professors

Thomas F. Brennan, Ph.D.  
Thomas R. Copeland, Ph.D.  
Geoffrey Davies, Ph.D.  
Claude Eon, D. es Sci.  
Arthur M. Halpern, Ph.D.  
James E. Quick, Ph.D.  
William M. Reiff, Ph.D.

## Admission

In addition to the admission requirements listed on page 22 an applicant must have completed not less than four full-year chemistry courses of the level required of an undergraduate major in chemistry. These must include organic, physical, and analytical chemistry. Admission policy favors those who have taken more chemistry than these minima. In addition, one year each of college physics and calculus are required, and further work in these subjects is desirable.

These admission requirements may be modified to accommodate applicants who have taken fewer courses than indicated above, but who have outstanding records and a strong interest in chemical or interdisciplinary studies. See also the description of interdisciplinary programs.

## DEGREE REQUIREMENTS

### Part-Time Program Leading to M.S. Degree

This program consists of a total of 40 quarter hours of credit in graduate course work, of which 32 credits must be taken in chemistry graduate courses numbered between 12.821 and 12.899. Eight additional credits may be taken in any graduate courses for which the student has the necessary prerequisites. The student's program must include the following core courses in the four areas of chemistry:

- (a) Four credits of analytical chemistry. These may be chosen from 12.821, 12.822, 12.823, 12.831 and 12.833.
- (b) Four credits of inorganic chemistry. These will normally be the 12.841 and 12.842 sequence.
- (c) Four credits of organic chemistry. These may be either the 12.861 and 12.862 sequence or the 12.864 and 12.865 sequence.
- (d) Four credits of physical chemistry. These may be either the 12.881 and 12.882 sequence or the 12.885 and 12.886 sequence. Note that 12.881 and 12.885, by themselves, are not sufficient.

In cases of unusual preparation, more advanced courses may be substituted within the given subdiscipline.

### **Full-Time Program**

#### **Master's Degree**

The normal full-time program consists of a total of 40 quarter hours of graduate credit in courses, seminars, research, and a thesis based on this research. Each student is required to take at least 24 quarter hours of credit in graduate chemistry courses numbered between 12.821 and 12.899. Up to 4 quarter hours of graduate courses in physics or mathematics may be substituted. At least one two-quarter sequence of courses must be taken in three out of the four areas of chemistry. These sequences would normally be chosen from the following core courses:

- (a) Analytical Chemistry — 12.821 and 12.831 or 12.823 and 12.833.
- (b) Inorganic Chemistry — 12.841 and 12.842
- (c) Organic Chemistry — 12.861 and 12.862
- (d) Physical Chemistry — 12.881 and 12.882 or 12.885 and 12.886.

A minimum of 6 hours, but no more than 14 quarter hours of credit may be assigned to 12.991, Research and Thesis for the Master of Science degree. Each student is required to attend 12.990, Seminar, in each term. One credit is assigned to a student for each term in which he conducts a seminar, up to the maximum of 2 credits.

### **DOCTOR OF PHILOSOPHY DEGREE**

The doctoral program in chemistry may be pursued only in residence. The additional requirements beyond those of the master's degree are designed to demonstrate superior proficiency in original research, including technical reading ability in a foreign language and familiarity with current advances in one of the main divisions of chemistry.

#### **Residence Requirement**

The residence requirement is satisfied after one year of full-time

graduate work or two years of half-time work. If a student holds a teaching assistantship which occupies one half of his time, his residence requirement is being discharged at half rate. Other arrangements require faculty approval. If a candidate has a research fellowship which supports his research for the doctoral dissertation, his residence requirement is discharged at full rate. Normally, the equivalent of two years of work after establishment of doctoral candidacy is necessary to complete research.

### **Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations.

### **Qualifying Examination**

Qualifying examinations are offered in the fields of analytical, inorganic, organic, and physical chemistry. There are eight examinations offered each year in each field. A student must pass four of these.

A student is eligible to take the qualifying examination if:

- (a) he has entered with a bachelor's degree and has achieved a 3.0 average in eight courses taken in the first year of residence. Two of the eight graduate courses may be in physics or mathematics, the remaining courses must be numbered between 12.821 and 12.899;
- (b) he has been admitted to the doctoral program with an awarded master's degree;
- (c) he is a part-time student who has petitioned the department after having completed at least sixteen credits of graduate courses which include fulfillment of three of the four distributional requirements listed for the part-time program. A 3.0 average is required for all courses taken.

Students in category "a" must pass the qualifying examinations by July 1 of their second year of residence. Students in category "b" must pass the qualifying examinations by July 1 of their first year of residence. Students in category "c" will have the conditions set at the time their petition is approved.

### **Course Requirements**

A candidate is normally required by his faculty adviser to do some course work beyond the 40 quarter hour minimum. The number and nature of these courses are individually determined for each candidate.

### **Dissertation**

In most cases, arrangements for a dissertation adviser will have been made before the completion of the qualifying examination. If not, such

arrangements must be made as soon as possible after degree candidacy has been established. The dissertation adviser directs the research for the dissertation and serves as chairman of the dissertation committee, which must approve the dissertation before the degree may be conferred.

### **Language Requirements**

Proficiency must be demonstrated in a foreign language as specified by the departmental graduate committee in accordance with the general graduate school regulations. French, German, and Russian are the acceptable foreign languages. Normally, proficiency is demonstrated by taking examinations administered by the Chemistry Department.

### **Final Oral Examination**

This examination will be held in accordance with the graduate school regulations.

## **AREAS OF ADVANCED STUDY AND RESEARCH**

### **Analytical Chemistry**

The general areas of active research include separation science, application of analytical methods to a wide range of problems of social relevance, and research in theoretical and applied analytical techniques such as electroanalytical chemistry, atomic absorption, and related areas.

### **Inorganic Chemistry**

Research in inorganic chemistry is largely concentrated on the structure and properties of transition elements and their compounds. Current investigations range from solid state studies to the thermodynamics and mechanism of reactions in solution. The application of inorganic chemistry in the field of forensic science is also under investigation.

### **Organic Chemistry**

Research in the organic chemistry division is concentrated in the areas of organic synthesis, organic reaction mechanisms and natural products, and phytochemistry.

### **Physical Chemistry**

The physical chemistry division has active research programs in the areas of photophysics, fluorescence spectroscopy, solution and gas phase photochemistry, molecular spectroscopy, physical solid state chemistry including X-ray diffraction, and theoretical studies of molecular systems.

## Research Facilities and Equipment

The main facilities of the department are located in Hurtig Hall. Substantial additional space and equipment are available in the Institute of Chemical Analysis, Applications and Forensic Science in Mugar Hall, in the Forsyth Building, and at the University's Marine Science Institute at Nahant. Major research equipment includes:

- ☐ electron spin, nuclear magnetic resonance, and mass spectrometers
- ☐ liquid and gas chromatographs and an atomic absorption spectrometer
- ☐ X-ray diffractometers, an electron microscope and thermal analyzers and calorimeters
- ☐ Gouy and Faraday magnetic balances and a vibrating sample magnetometer
- ☐ vacuum ultraviolet, electron impact, photoionization, ultraviolet, visible, and infrared spectrometers
- ☐ flash photolysis, laser photolysis, and photochemical equipment
- ☐ Mössbauer spectrometer and low temperature facilities
- ☐ fluorescence emission and lifetimes and a stopped-flow apparatus
- ☐ electroanalytical, polarographic, and coulometric equipment

## Interdisciplinary and Other Graduate Chemistry Programs

Some graduate students wish to pursue doctoral programs which involve substantial work in two or more departments. The chemistry department has served as the registration department for a number of students engaged in such areas. The details of establishing such a program tailored to a student's individual needs are explained on page 26 of this bulletin.

## Interdisciplinary Ph.D. in Forensic Chemistry

This program is designed to prepare a student for research and leadership positions in forensic laboratories. It is offered in conjunction with the College of Criminal Justice and the Institute of Chemical Analysis, Applications and Forensic Science. Details are given on page 58.

## Master of Science in Forensic Chemistry

This program is available on a full-time or part-time basis with courses being offered primarily during the evening hours. Details are given on page 59.

## Master of Science in Clinical Chemistry

This is a part-time interdisciplinary program with the College of Pharmacy and Allied Health Professions. It is designed to prepare a student for employment in clinical laboratories. Details are given on page 54.

### DESCRIPTION OF COURSES

*All courses carry two quarter hours of credit unless otherwise specified.*

#### 12.810 Modern Methods of Analysis (3 q.h.)

Training in a wide variety of modern methods of instrumental analysis with extensive "hands-on" experience provided by a laboratory section. Areas covered include: data handling; spectroscopy (UV-visible and IR absorption, luminescence, X-ray, atomic absorption and mass spectrometry); separations (gas and modern liquid chromatography, TLC); pulse polarography; X-ray diffraction; microscopy (optical and scanning electron microscopy including X-ray fluorescence microanalysis); computerized instrumentation. (Restricted to students in the Forensic Chemistry M.S. program).

#### 12.811, 12.812, 12.813 Special Topics in Chemistry — Chemistry and Society I, II, III

Special topics of current importance including: Chemical Aspects of the Environment: pollution and its determination, pesticides, carcinogenics, resources; Chemical Aspects of Energy Conversion and Storage: fossil fuels and fuel analysis; nuclear reactors; storage batteries; hydrogen production and storage; solar energy, photovoltaic cells and photochemistry; energy related materials. *Prep. Bachelor's degree in science or engineering.*

#### 12.821 Analytical Separations

Theory and practice of analytical separation techniques. Emphasis will be on fundamentals as they relate to practice. Topics will be based mainly on chromatographic processes including gas and high speed liquid chromatography. Other topics will include zone refining, liquid-liquid extraction, and electrophoresis.

#### 12.822 Electroanalytical Chemistry

The principles and practice of electroanalytical chemistry will be discussed. Topics will include potentiometry and ion-selective electrodes, normal and thin-layer coulometry, polarography, and electrochemical relaxation methods. Application of these techniques to titration endpoint detection will also be discussed.

#### 12.823 Optical Methods of Analysis

Theory and practice of atomic absorption, fluorescence, and emission spectrometry. Use of flames, plasmas, and electrically heated rods, tubes, and furnaces as atom reservoirs. Molecular absorption and fluorescence, Raman spectrometry.

#### 12.824, 12.825, 12.826 Special Topics in Analytical Chemistry I, II, III

Selected topics of current importance in analytical chemistry.

#### 12.828 Chemical Instrumentation

Principles of instrument design will be considered with emphasis on practical

aspects. Instrument limitations and sources of error will be considered along with modular instruments and interfacing. *Prep. Consent of instructor.*

### **12.829 Computers In Chemistry (3 q.h.)**

A laboratory-lecture course illustrating the use of small digital computers for real-time control of chemical instruments. Topics will include digital logic, real-time data structures, A/D and D/A conversion, noise, and other aspects of real-time computer interfacing. Programming will be done on a PDP-11 computer in MIRACL, a language designed for real-time processing. *Prep. Consent of instructor.*

### **12.831 Advanced Analytical Separations**

Continuation of 12.821. *Prep. 12.821.*

### **12.833 Advanced Optical Methods of Analysis**

A detailed discussion of parameters affecting analytical spectrometric measurements. Optics: pre, post, and inner filter effects; modulation and transform techniques; factors affecting signal-to-noise ratios; interferences; quenching; scattering; novel detectors; and other topics will be covered. *Prep. 12.823.*

### **12.841 Advanced Inorganic Chemistry I**

Application of basic quantum chemistry to inorganic systems. Russell-Saunders and j-j coupling. Stereo chemistry of non-transition-metal compounds; bonding and structure of electron deficient systems.

### **12.842 Advanced Inorganic Chemistry II**

Magnetic properties; electronic spectra and selection rules. Thermodynamic stability of coordination compounds. Experimental techniques of inorganic chemistry. *Prep. 12.841.*

### **12.843 Advanced Inorganic Chemistry III**

Crystal symmetry. Introduction to theory of solids; semi-conductors and metals; non-stoichiometric compounds; solid state reactions. Application of molecular orbital theory. Determination of electron distribution in transition metal compounds. Mössbauer spectroscopy and advanced magneto-chemistry. *Prep. 12.842 and 12.885.*

### **12.846 Coordination Chemistry**

Solution phase properties of coordination compounds. Experimental methods for the study of thermodynamics stability and kinetic lability. Kinetics and mechanism of solvent exchange and substitution reactions at transition metal centers. Classification of redox reaction mechanisms. Marcus theory. Phenomenological mechanisms. *Prep. 12.843.*

### **12.847, 12.848, 12.849, 12.850 Special Topics In Inorganic Chemistry I, II, III, IV**

Advanced topics of importance in inorganic chemistry including: Advanced Ligand Field Theory: Crystal field theory of ions in weak and strong fields. Molecular orbital theory of transition metal complexes. Crystal Structure Determination in Solids: Crystallography, X-ray, electron and neutron diffraction techniques applied to inorganic, bio-inorganic and other solids. Resonance Spectroscopy in Inorganic Chemistry: Electron spin resonance, nuclear magnetic resonance, nuclear quadrupole resonance and Mössbauer Spectroscopy. Solid State Chemistry: Thermal, magnetic and transport properties; phase transformations and crystal defects;

surface effects; material preparation techniques. *Prep. 12.842 and consent of instructor.*

### **12.861, 12.862 Advanced Organic Chemistry I, II**

An intensive survey of organic reactions. Modern concepts of structure and mechanism are used to correlate factual material. *Prep. One year of Organic Chemistry.*

### **12.863 Physical Organic Chemistry**

Topics in basic physical organic chemistry: molecular polarity, equilibrium and kinetics, reactivity and structure, solvent effects, acid-base catalysis, orbital symmetry, aromaticity, etc. *Prep. 12.862 or consent of instructor.*

### **12.864, 12.865 Organic Stereochemistry and Reaction Mechanisms I, II.**

Interrelations of the stereochemistry of organic molecules with their physical and chemical behavior. Conformational analysis. The effects of spatial relationships on transition states, equilibria and reaction rates as an introduction to the study of organic reaction mechanisms. *Prep. 12.863.*

### **12.866 Spectrometric Identification of Organic Compounds**

Interpretation of the ultraviolet, infrared and nuclear magnetic resonance spectra of organic compounds. *Prep. One year of Organic Chemistry.*

### **12.871, 12.872, 12.873 Special Topics In Organic Chemistry I, II, III**

Selected topics of current importance in organic chemistry. *Prep. 12.862 and consent of instructor.*

### **12.876, 12.877 Organic Reaction Mechanisms and Organic Synthesis I, II.**

The fundamental factors influencing the courses of organic reactions. Substitution reactions. Pericyclic reactions. Synthetic methods as an introduction to organic synthesis. *Prep. 12.865 or concurrent registration therein.*

### **12.881 Chemical Thermodynamics I**

First Law of Thermodynamics, Thermochemistry, Second and Third Laws, Free Energies, Reaction and Phase Equilibria. *Prep. consent of instructor.*

### **12.882 Chemical Thermodynamics II**

Partial Molar Properties, Solutions, Electrolytes. Statistical Analogues of Entropy and Free Energy, Partition Functions. *Prep. 12,881.*

### **12.883 Chemical Thermodynamics III**

Statistical Thermodynamics applied to gases, liquids and solids. Irreversible Thermodynamics. *Prep. 12.882 and 12.886.*

### **12.885 Introductory Quantum Chemistry I**

Introduction to quantum mechanics. Application to simple systems. Perturbation theory and applications. Harmonic oscillator, rigid rotor and applications to microwave and infrared spectroscopy. Simple atoms. *Prep. One year of Physical Chemistry.*



**12.886 Introductory Quantum Chemistry II**

The variational method. The chemical bond.  $H_2^+$ . The LCAO method. Group theory and applications. Molecules. Woodward-Hoffman rules. *Prep. 12.885.*

**12.887 Introductory Quantum Chemistry III**

Application of group theory and simple approximate theories to conjugated molecules. The SCF method and its application to atoms and molecules. Applications to molecular spectroscopy. *Prep. 12.886.*

**12.890, 12.891, 12.892 Special Topics In Physical Chemistry I, II, III**

Advanced topics of importance in physical chemistry including: Quantum Chemistry: Linear algebra and the formulation of quantum theory. Angular momentum. Group theory. Small molecules. Time-dependent theory and selected advanced topics. Statistical Mechanics: Quantum statistics; electrons in metals, photons and phonons; superconductivity; fluctuations, noise and irreversible thermodynamics; transport phenomena; phase transitions of high order. *Prep. consent of instructor.*

**12.893 Chemical Kinetics**

Use of experimental data to deduce the rate law of a reaction. Mechanisms deduced from rate laws. Influence of experimental error on precision of rate constants and activation energies. Collision and transition state theories of reaction rates. *Prep. One year of physical chemistry.*

**12.901 Polymer Chemistry I**

Introduction to polymers. Major emphasis on synthesis. Step-reaction, chain-reaction, and ring-opening polymerizations. Copolymerization. Three-dimensional polymers and crosslinking. *Prep. One year of Organic Chemistry and one year of Physical Chemistry.*

**12.902 Polymer Chemistry II**

Physical chemistry of polymers in solution and bulk. Molecular characterization. Mechanical and physical properties in the glassy, rubbery, viscous, and semi-crystalline states. *Prep. 12.901.*

**12.903 Polymer Chemistry III**

Industrial practice. Polymer processing. Fibers. Elastomers. Coatings. Adhesives. Reinforced plastics. Relationship of polymer structure to usage. *Prep. 12.902.*

**12.910 Special Projects In Chemistry**

Laboratory studies on a topic not directly related to research pursued for a thesis. *Prep. Permission of the departmental faculty is required.*

**12.990 Seminar (1 q.h.)**

Oral reports by the participants on current investigations in chemistry. *Prep. Enrollment in full-time program.*

**12.991 Research and Thesis for M.S. (maximum: 14 q.h.)**

Original research and a written thesis thereon, under supervision of a faculty member.

**12.995 Research and Dissertation for Ph.D.**

Original research in depth, representing a significant contribution of new chemical

knowledge, and a written dissertation thereon, under the supervision of a faculty member.

#### **90.821 Biochemistry I**

Discussion of the structures and chemistries of carbohydrates, proteins, lipids, nucleic acids, and selected cofactors. *Prep. One year organic chemistry.*

#### **90.822 Biochemistry II**

Bioenergetics, enzymes and enzyme kinetics, intermediary metabolism including carbohydrate catabolism, tricarboxylic acid cycle, electron transport, and oxidative phosphorylation. *Prep. Biochemistry I, 90.821.*

#### **90.823 Biochemistry III**

Continuation of intermediary metabolism from Biochemistry II, including lipid, protein, and nucleic acid metabolism, photosynthesis and cell regulation. *Prep. Biochemistry II, 90.822.*

*See Biology Department offerings and College of Pharmacy offerings for other courses on chemical topics.*

## **clinical chemistry**

### **MASTER OF SCIENCE IN CLINICAL CHEMISTRY**

#### **Part-Time Program**

#### **Admission**

In addition to the admissions requirement listed on page 22, the applicant must have completed a baccalaureate program in biology, chemistry, medical technology, or pharmacy. Undergraduate requirements in this program are a minimum of two quarters of organic chemistry, two quarters of analytical chemistry (each with a laboratory or its equivalent), two quarters of human physiology, and two quarters of physical chemistry. An individual who has deficiencies in any of these areas may take appropriate evening courses at Northeastern University concurrently with those graduate courses which do not require the deficient prerequisites. The appropriate evening courses offered at University College of Northeastern University are: Analytical Chemistry 12.521-6, Organic Chemistry 12.531-3, Physical Chemistry 12.541-3, Human Anatomy and Physiology 18.524-6. Equivalent courses from this university or other universities will be accepted.

## Program

The Master of Science in Clinical Chemistry is an interdisciplinary program with the College of Pharmacy and Allied Health Professions. Forty quarter hours of academic coursework are required. In addition, a student must have at least one year of acceptable clinical laboratory experience prior to completion of academic degree requirements. Students in good standing in the program who lack this experience requirement may apply for an applied study (training) course in clinical chemistry. This course is offered through the College of Pharmacy and Allied Health Professions of Northeastern University at one of nearby affiliated hospitals, and provides three months of this experience requirement. Individuals who have completed this course achieve an enhanced opportunity to obtain subsequent employment in this field and thereby satisfy the one year of experience requirement.

The program is available on a part-time basis with courses offered primarily during the evening hours. Courses are scheduled in the Fall, Winter, Spring, and Summer Quarters. The following are core courses required in the program:

	<b>Total Credits</b>
12.821 Analytical Separations	2
12.823 Optical Methods of Analysis	2
72.834 Clinical Chemistry I	2
72.835 Clinical Chemistry II	2
72.837 Seminar and Report in Clinical Chemistry*	2
73.845 Radioisotopes in Biological Systems	2
87.807 Biometrics	2
87.810 Functions of Human Systems	2
90.821 Biochemistry I	2
90.822 Biochemistry II	2
90.823 Biochemistry III	2
	<hr/>
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\*The first quarter of 72.837 is a required course. However, the course may be repeated twice as an elective.

Twelve additional credits must be taken from the following elective core courses:

	<b>Credits</b>
12.822 Electroanalytical Chemistry	2
12.824 Special Topics in Analytical Chemistry I	2
12.825 Special Topics in Analytical Chemistry II	2
12.828 Chemical Instrumentation	2
12.829 Computers in Chemistry	3
72.836 Protein Analysis	2
72.837 Seminar and Report in Clinical Chemistry	2
72.861 Central Nervous System Depressants	2
72.862 Autonomic Drugs	2
72.863 Anti-infectives	2

72.864	Cancer Therapy	2
72.865	Special Topics in Medicinal Chemistry	2
73.816	Concepts in Toxicology I	2
73.817	Concepts in Toxicology II	2
73.844	Drug Metabolism	2
87.811	Pathophysiology I	2
87.812	Pathophysiology II	2

Taken with the approval of the Admissions Committee and the course instructor, selection may be made from the above courses as well as the following and other appropriate graduate courses in the University.

		Credits
12.841	Advanced Inorganic Chemistry I	2
12.842	Advanced Inorganic Chemistry II	2
12.846	Coordination Chemistry	2
12.861	Advanced Organic Chemistry I	2
12.862	Advanced Organic Chemistry II	2
12.863	Physical Organic Chemistry	2
12.866	Spectrometric Identification of Compounds	2
12.881	Chemical Thermodynamics I	2
12.885	Introductory Quantum Chemistry I	2
12.893	Chemical Kinetics	2
18.245	Immunology	3
18.840	Comparative Physiology of Regulatory Mechanisms	2
18.842	Vertebrate Endocrinology	2
18.843	Procedures in Endocrinology	3
18.860	Cell Biophysics and Biochemistry	5
18.909	Animal Virology	4
18.940	Microbial Biochemistry	4
72.837	Seminar and Report in Clinical Chemistry	2
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.818	Special Topics in Pharmacology	2
73.819	Pharmacological Instrumentation	2
72.866	Phytochemistry	2
87.802	Advanced MLS Hematology and Immunology	2

### DESCRIPTION OF COURSES

*All courses carry two quarter hours of credit unless otherwise indicated.*

Courses with the prefix number 12 are chemistry offerings. Their descriptions may be found in the preceding section of this bulletin along with interdisciplinary biochemistry courses (prefix number 90).

#### **72.834 Clinical Chemistry I**

Principles, instrumentation, methodology, and interpretations in clinical chemistry. *Prep. 90.823.*

#### **72.835 Clinical Chemistry II**

A Continuation of Clinical Chemistry I. *Prep. 72.834.*

**72.836 Protein Analysis**

Laboratory and discussion of electrophoretic and immunochemical methods of analysis of proteins of clinical or forensic interest. *Prep. 72.835.*

**72.837 Seminar and Report in Clinical Chemistry**

Reports and discussions of current journal articles in clinical chemistry. *Prep. 72.835.*

**72.861 Central Nervous System Depressants**

Presentation and discussion of the chemistry, structure-activity relationships, and mechanism of action of general anesthetics, hypnotics and sedatives, anti-epileptics, analgetics, tranquilizers, and muscle relaxants. A consideration of the mechanics of drug design and methods of modification will be undertaken. *Prep. Two quarters of Organic Chemistry. Offered alternate years.*

**72.862 Autonomic Drugs**

A discussion of drugs acting on the central nervous system with a special emphasis on the mechanism of action of the chemical mediators of the peripheral nervous system. The role of agents affecting this system—adrenergic and cholinergic and reversible and irreversible inhibitors of these systems will be discussed in relation to their chemical structure and biological activity. *Prep. Two semesters of Organic Chemistry. Offered alternate years.*

**72.863 Anti-Infectives**

A study of the various chemotherapeutic agents employed in the treatment of infectious diseases. Included will be the sulfonamides, antibiotics, antivirals, antitubercular, antifungal, and antimalarial agents. Special emphasis will be on structure-activity relationships, mechanisms of action, and modern research in each area. *Prep. Two quarters of Organic Chemistry. Offered alternate years.*

**72.864 Cancer Therapy**

Recent developments in new approaches to the treatment of cancer from a chemotherapeutic standpoint will be considered: including alkylating agents, antimetabolites, hormones, and miscellaneous compounds, and combinations of the above with radiation and immunology. Possible mechanisms of action will be explored. *Prep. Two quarters of Organic Chemistry. Offered alternate years.*

**72.865 Special Topics in Medicinal Chemistry**

A consideration of a special area of medicinal chemistry including either CNS compounds, pharmacodynamic agents or chemotherapeutics; their chemistry and structure-activity relationships will be presented. *Prep. Two quarters of Organic Chemistry. Offered alternate years.*

**72.866 Phytochemistry**

The important classes of chemical compounds produced by plants considered from the standpoint of their biogenetic origin, methods for their detection, isolation and characterization; application of these techniques to research in pharmacy, medicine, economic botany, taxonomy; and introduction to the literature of plant chemistry. *Prep. Two quarters of Organic Chemistry, two quarters of Biology. Offered alternate years.*

**73.816 Concepts In Toxicology I**

Concepts of modern toxicology in which emphasis is placed on biochemical mechanism underlying the toxicological action of drugs and other chemical substances upon biological systems. Selected topics in toxicology including acute, sub-acute, and chronic effects of drugs in the experimental animal and man. Consideration of the predictive value of animal studies for drug effects in man. *Prep. Permission of Instructor. Offered alternate years.*

**73.817 Concepts In Toxicology II**

Continuation of Concepts in Toxicology I. *Prep. 73.816. Offered alternate years.*

**73.844 Drug Metabolism**

Presentation of detoxication mechanisms relating to drug metabolism and excretion patterns: adaptive factors influencing metabolism will be discussed. *Prep. Biochemistry I, 90.821.*

**73.845 Radiolotopes In Biological Systems**

Methodology of radioactive nuclides and application of these isotopes to biology and medicine with special emphasis on their use in clinical analysis.

*Other biology, chemistry, and pharmacy courses may be taken with the approval of the admissions committee and the course instructor.*

## **forensic chemistry**

### **INTERDISCIPLINARY PH.D. PROGRAM IN FORENSIC CHEMISTRY**

This program is being offered in conjunction with the College of Criminal Justice and Northeastern University's Institute of Chemical Analysis, Applications and Forensic Science. This unique program is designed as a preparation for research and leadership positions in forensic laboratories. The Chemistry Department is the registering department for two of the three specializations of this program, namely, forensic analytical chemistry and forensic materials science; a third specialization, forensic toxicology, is administered by the College of Pharmacy, again in connection with the College of Criminal Justice. Admission is made through the registering department.

For students entering with a B.S., completion of the M.S. course requirements in Forensic Chemistry (described below, page 59) with a B average is required to qualify for further Ph.D. study. For students with M.S. degrees in forensic science or the natural sciences, individual programs are planned according to the student's background. The course of study includes comprehensive examinations, thesis research to be carried out at the Institute of Chemical Analysis, Applications and Forensic Science and an internship at a major forensic laboratory engaged in research.

## MASTER OF SCIENCE IN FORENSIC CHEMISTRY

### Full-Time and Part-Time Program

#### Admission

In addition to the admissions requirements listed on page 22, the applicant must have completed a baccalaureate degree in the physical or life sciences. Undergraduate courses must include general chemistry, organic chemistry, analytical chemistry, physics, and calculus. An individual who has deficiencies in any of these areas may take the appropriate courses at Northeastern University concurrently with those graduate courses which do not require the deficient prerequisites. Although they are not prerequisites for the program, courses in general biology, botany, microbiology and computer science are desirable.

#### Program

The Master of Science in Forensic Chemistry is an interdisciplinary program involving cooperation among the College of Liberal Arts, the College of Criminal Justice, and the Institute of Chemical Analysis, Applications and Forensic Science. Forty-two quarter hours of academic graduate coursework are required, including a Master's paper. In addition, a three-months internship consisting of full-time work in an approved, practicing forensic laboratory is required. The full-time program will thus generally encompass five quarters; this may be reduced to four quarters if the student can demonstrate to the satisfaction of the program committee the prior completion of three months or more of equivalent forensic laboratory experience. The program is available on a full-time or part-time basis; courses are offered primarily during the evening hours. Graduate courses are scheduled in the Fall, Winter, and Spring Quarters. The following are core courses required in the program.

Required Courses		Credits
12.810	Modern Methods of Analysis	3
73.816	Concepts in Toxicology I	2
87.807	Biometrics	2
90.821	Biochemistry I	2
92.824	Legal Aspects of Forensic Science	3
92.904	Administration of Criminal Justice	3
92.921	Arson and Explosives	3
92.931	Crime Scene Investigation	3
93.950	Forensic Materials	2
93.951	Forensic Chemistry Techniques I	4
93.952	Forensic Chemistry Techniques II	4
93.953	Seminar	1
93.954	Master of Science Paper	4

Six additional credits must be taken from the following list of elective courses.

2.970	Material Science and Engineering	2
2.971	Material Science and Engineering	2
12.821	Analytical Separations	2
12.822	Electroanalytical Chemistry	2
12.823	Optical Methods of Analysis	2
12.824	Special Topics of Analytical Chemistry I	2
12.825	Special Topics of Analytical Chemistry II	2
12.826	Special Topics of Analytical Chemistry III	2
12.861	Advanced Organic Chemistry I	2
12.862	Advanced Organic Chemistry II	2
12.863	Physical Organic Chemistry	2
12.866	Spectrometric Identification of Organic Compounds	2
12.901	Polymer Chemistry I	2
12.902	Polymer Chemistry II	2
12.903	Polymer Chemistry III	2
72.834	Clinical Chemistry I	2
72.835	Clinical Chemistry II	2
72.861	C N S Depressants	2
72.862	Autonomic Drugs	2
73.814	Concepts in Pharmacology I	2
73.815	Concepts in Pharmacology II	2
73.817	Concepts in Toxicology II	2
73.844	Drug Metabolism	2
90.822	Biochemistry II	2
90.823	Biochemistry III	2
92.913	Criminal Justice Planning and Development	3
92.841	Criminal Law	3



# economics

## **Professors**

Morris A. Horowitz, Ph.D.,  
Chairman  
Harold M. Goldstein, Ph.D.  
Irwin L. Herrnstadt, Ph.D.  
Peggy Musgrave, Ph.D.  
Gustav Schachter, Ph.D.  
Donald Shelby, Ph.D.

## **Associate Professors**

Conrad P. Caligaris, Ph.D.  
Ernest M. DeCicco, Ph.D.  
Daryl A. Hellman, Ph.D.  
Sungwoo Kim, Ph.D.  
Pawan K. Sawhney, Ph.D.

## **Assistant Professors**

Yudhishter L. Mahajan, Ph.D.  
Joel Naroff, Ph.D.  
Andrew Sum, M.A.

The Economics Department offers four terminal programs with different admission requirements and program form and content in an effort to serve students with varying backgrounds, interests, and goals. These programs are: a non-degree certificate program, an M.S. degree program in economic policy and planning, an M.A. degree program with specialization in one of four available fields, and a doctoral degree program.

## **CERTIFICATE PROGRAM**

The Economics Department offers a non-degree program in the Economics of Manpower and Development Planning. Upon completion of the prescribed program, students will receive a certificate issued by the Graduate School of Arts and Sciences, Northeastern University. The program is designed for students interested in a specialized program of courses in manpower and development planning but who do not wish to meet the requirements of a degree program.

## **Admission**

Admission to the program will be considered for graduates of recognized universities or institutes of technology, although practical experience in manpower planning or development planning may be substituted for the

admission requirements at the discretion of the faculty. All foreign students must submit a TOEFL test score or an equivalent certification of the applicant's proficiency in English along with the application and academic transcripts.

### **Program**

This certificate program is designed to be completed in one year. Students admitted to the program may not transfer into the regular degree programs. Evidence of completion of a course and of the program shall be attendance, all required reading, and all written work. Successful completion of a course shall be noted by a pass designation.

#### **Fall Quarter** (All four courses required)

- 39.9B0 Introductory Macroeconomic Theory
- 39.9A0 Introductory Microeconomic Theory
- 39.9G1 Economics of the Labor Market
- 39.9P1 Economic Development

#### **Winter Quarter** (Select any two of three electives listed)

- 39.250 Statistics (Required)
- 39.9G4 Manpower Planning I (Elective)
- 39.9P4 Regional Development (Elective)
- 39.9Q1 Development Finance (Elective)

#### **Spring Quarter** (Select any three of four courses listed)

- 39.9J1 Seminar in Human Resource Development
- 39.9R1 Seminar in Development Planning
- 39.9G5 Manpower Planning II
- 39.9P6 Comparative Economic Development

Variations in this basic program are possible only with prior approval of the Graduate Director.

## **THE MASTER OF SCIENCE DEGREE IN ECONOMIC POLICY AND PLANNING**

Forty-one quarter hours of academic work are required. The program consists of 20 quarter hours of required courses and 21 quarter hours of electives. With the approval of the program advisor, a student may select a maximum of 9 quarter hours from graduate courses offered by other departments. This is a terminal degree program designed mainly for working economists, government agency officials, and middle echelon employees in the private sector.

### **Admission**

Applicants must meet the general admission regulations of the Graduate School of Arts and Sciences.

## Comprehensive Examination

After completion of courses, a comprehensive examination is required of all students to test their ability to apply concepts and tools in the broad field of economic policy and planning. The examination may be repeated only once.

## Master's Thesis

A Master's thesis for a maximum of six quarter hours of credit is optional, with the approval of the program advisor.

## Course Requirements

A. Required Core Courses	Q.H. Credits
39.9A0 Introductory Microeconomic Theory	4
39.9B0 Introductory Macroeconomic Theory	4
39.9F0 Introduction to Statistics/Mathematics	4
39.9F1 Economic Policy and Planning I	4
39.9F2 Economic Policy and Planning II	4

### B. Elective Courses

A total of twenty-one hours of electives (12 of which must be economics courses) may be selected by the student in accordance with interests and needs. Electives may be concentrated in any of the available areas or may be distributed among fields to obtain a broader exposure. All economics electives are 3 quarter hour credits. A maximum of 6 credits for courses taken at other institutions may be accepted if taken during the past 7 years.

## THE MASTER OF ARTS DEGREE

Forty quarter hours of academic work are required. This program comprises 16 quarter hours of required core course work and 24 quarter hours of electives of which a minimum of twelve quarter hours must be selected from one of the economic fields listed below. The required core courses must be completed as soon as possible. With the approval of the graduate adviser, a student may select a maximum of six quarter hours from graduate courses offered by other departments, or two advanced undergraduate courses in economics carrying three quarter hours of graduate credit.

## Admission

In addition to the general admission requirements of the Graduate School of Arts and Sciences, applicants should have had a minimum of 12 semester hours of economics, or the equivalent, of which three semester hours, or the equivalent, should be statistics. Admission is only possible in the Fall and Winter Quarters. Application for admission to the Fall Quarter

will be given consideration if received by August 31. Applications for admission to the Winter Quarter will be given consideration if received by November 30.

Applications for financial aid should be submitted no later than March 15. See page 31 for information on financial aid available.

### Comprehensive Examination

A comprehensive examination, which will be held in accordance with the general graduate school regulations, must be taken by all students during the quarter in which the student completes the 40 quarter hours of academic work. The examination may be repeated only once.

### Master's Thesis

A master's thesis for six quarter hours of credit is optional with the approval of the graduate adviser. Approval will be granted only in those instances in which previous graduate work of the student indicates capacity for independent study.

### Required Core Courses\*

The required core courses are:

	<b>Credits</b>
39.9A1 Microeconomic Theory** . . . . .	4
39.9B1 Macroeconomic Theory** . . . . .	4
39.9E1 Statistical Inference . . . . .	4
39.9E7 Econometrics I . . . . .	4

### Economic Fields

Available economic fields are listed below. Under each field are stated the required field courses and the elective field courses. Students must take at least twelve quarter hours in one field of concentration. In all fields the first listed required course in the field ordinarily should be taken first by the student majoring in the field. For students not majoring in the field, courses in the field may be taken in any sequence.

#### Manpower Economics

Required field courses:

- 39.9G1 Economics of the Labor Market and Labor Force
- 39.9G4 Economics of Manpower Planning I
- 39.9J1 Seminar in Human Resource Development

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\* Students must demonstrate competence in mathematics by taking a mathematics examination given by the department during registration week prior to the start of the Fall Term. Students must pass this exam or register for 39.9D0.

\*\*Candidates deficient in intermediate theory may not be admitted into these core courses until they have completed 39.9A0 and/or 39.9B0.

## Elective field courses:

- 39.9G5 Economics of Manpower Planning II
- 39.9G7 Human Resources and Labor Problems and Policies
- 39.9H1 Economics of Medical Care and Health Manpower
- 39.9H3 Economics of Education

**Urban/Regional Economics**

## Required field courses:

- 39.9K1 Regional Economics
- 39.9L1 Urban Economics I
- 39.9N1 Seminar in Urban/Regional Economics

## Elective field courses:

- 39.9K5 Economics of Crime
- 39.9L2 Urban Economics II
- 39.9L5 Economics of Urban Transportation
- 39.9L7 Economics of Inter-City Transportation
- 39.9M1 Intergovernmental Fiscal Relations

**Development Economics**

## Required field courses:

- 39.9P1 Economic Development
- 39.9P3 Regional Development
- 39.9R1 Seminar in Development Planning

## Elective field courses:

- 39.9P6 Comparative Economic Development
- 39.9Q1 Development Finance
- 39.9G4 Economics of Manpower Planning I
- 39.9K1 Regional Economics

**Economics of Money and Finance**

## Required field courses:

- 39.9S1 Monetary Theory
- 39.9S3 Monetary Policy
- 39.9V1 Seminar in Money and Finance

## Elective field courses:

- 39.9T1 Public Policy and Finance
- 39.9T5 Capital Markets
- 39.9Q1 Development Finance
- 39.9M1 Intergovernmental Fiscal Relations

**THE DOCTOR OF PHILOSOPHY DEGREE**

The doctoral degree program in economics is offered in the fields of manpower, urban-regional, development, and monetary economics.

## **Admission**

Applicants who will have a master's degree in economics or its equivalent at entry may be considered for direct admission to the doctoral program. Applicants who will not have a master's degree in economics or its equivalent at entry may apply for admission to the doctoral program after the satisfactory completion of 40 quarter hours of graduate work.

Admission to the doctoral program is possible only in the Fall Quarter. Applications for the doctoral program must be submitted no later than March 15.

## **Residence Requirement**

After acceptance to the doctoral program, the student may satisfy the residence requirement by one year of full-time graduate course work. Teaching assistants may satisfy the residence requirement by two consecutive years of half-time graduate course work. A student should expect to spend at least two academic years in full-time study, or its equivalent, completing the requirements for the doctoral degree.

## **Degree Candidacy**

Degree candidacy is established in accordance with the general graduate school regulations.

## **Course Requirements**

A. At least 32 quarter hours of graduate work beyond the master's degree are required. These include:

### **Required Core Courses:**

- 39.9A2 Microeconomics II
- 39.9B2 Macroeconomics II
- 39.9D1 Mathematics for Economists
- 39.9E8 Econometrics II

B. Concentration in one academic field. Course work in the field must include the doctoral seminar sequence 39.9C1 and 39.9C2. This seminar has a prerequisite of 12 quarter hours of graduate course work in the field.

## **Qualifying Exam**

Each student must pass comprehensive qualifying examinations after the completion of the required core and field courses. These exams are: (1) a two-hour written exam in macroeconomic theory; (2) a two-hour written exam in microeconomic theory; (3) a two-hour written exam in quantitative methodology; (4) a three-hour written exam in one doctoral field; and (5) a two-hour general oral exam. Passing the qualifying exams signifies that the student has completed all course requirements and can now devote all the time to dissertation. An examination may be repeated only once.

## Doctoral Dissertation

An original doctoral dissertation is required of all students in accordance with the general graduate school regulations and the regulations established by the department. After the successful completion of the qualifying examination, each student shall work with a dissertation adviser under whose guidance he will write the doctoral dissertation. The dissertation adviser serves as chairman of the dissertation committee which must approve the dissertation before the degree may be conferred.

## Final Oral Examination

The final oral examination will be established in accordance with the general graduate school regulations.

## DESCRIPTION OF COURSES

*All courses carry three quarter hours of credit unless otherwise specified.*

*Courses indicating microeconomic theory as a prerequisite refer to 39.9A0 for M.S. degree students and 39.9A1 for M.A. degree students.*

*Courses indicating macroeconomic theory as a prerequisite refer to 39.9B0 for M.S. degree students and 39.9B1 for M.A. degree students.*

### 39.9A0 Introduction to Intermediate Microeconomic Theory

Intensive coverage of basic micro theory. This course carries academic credit for the M.S. degree program but no credit toward the M.A. or Ph.D. programs.

### 39.9A1 Microeconomic Theory I (4 q.h.)

A non-math treatment of microeconomic theory at the beginning graduate level. An investigation of the conditions underlying consumer and producer equilibrium under different objective functions and various market structures. Derivation of product demand curves, supply curves, and factor demand curves for alternative market structures in product and factor markets are surveyed.

### 39.9A2 Microeconomic Theory II (4 q.h.)

An examination of contemporary microeconomic problems and theory with specific emphasis on welfare economics, general equilibrium, distribution, the theory of the firm, and the ability of modern value theory to reach meaningful and feasible policy conclusions. *Prep. 39.9A1 and consent of instructor.*

### 39.9B0 Introduction to Intermediate Macroeconomic Theory

Intensive coverage of basic macro theory. This course carries academic credit for the M.S. degree program but no credit toward the M.A. or Ph.D. programs.

### 39.9B1 Macroeconomic Theory I (4 q.h.)

Income and employment theory; classical, Keynesian, and post-Keynesian aggregate demand and supply systems.

### 39.9B2 Macroeconomic Theory II (4 q.h.)

Theory and problems of macro-dynamics, growth, inflation, cycles, and stabilization policy. *Prep. 39.9B1 and consent of instructor.*

**39.9C1 Doctoral Research Seminar I (4 q.h.)**

*Prep. 12 q.h. of field work and consent of instructor.*

**39.9C2 Doctoral Research Seminar II (4 q.h.)**

*Prep. 39.9C1.*

**39.9D0 Introduction to Mathematics for Economists (4 q.h.)**

This course acquaints the student with the algebra and elementary calculus necessary for quantitative economics: simultaneous linear systems; polynomial, logarithmic, and exponential functions; and elementary differential and integral calculus. *This course offers no credit toward a degree in economics.*

**39.9D1 Mathematics for Economics (4 q.h.)**

Application of matrix algebra and simple multivariate calculus to economic analysis. Static organization and dynamic analysis, difference and differential equations. Examples from economic theory. *Prep. 39.9D0 or mathematics examination.*

**39.9E1 Statistical Inference (4 q.h.)**

A study of statistical methods and techniques used in economic analysis. Descriptive statistics, index number and time series problems, sampling problems, testing economic hypotheses, estimation techniques, correlation and regression analysis, analysis of variance.

**39.9E5 Economic Programming**

Economic programming with emphasis on linear programming, including the transportation and simple problems, and simulation and queuing theory with applications to the computer. *Prep. 39.9D1.*

**39.9E7 Econometrics I (4 q.h.)**

Review of matrix algebra; single equation least squares estimates and their theoretical properties; hypothesis testing and measures of goodness of fit; definitions of and tests for autocorrelation, heteroskedasticity, and multicollinearity; simultaneous equations estimation: identification, bias, and alternative estimation techniques. *Prep. 39.9E1.*

**39.9E8 Econometrics II**

Asymptotic and small sample properties of various estimators; rank-order conditions for identification; specification error and error in variables; remedies for autocorrelation and multicollinearity; dummy variables; distributed lags; forecasting and simulation; non-linear estimation; alternative estimation technique (two-stage least squares, three-stage least squares, maximum likelihood estimators, etc.). *Prep. 39.9E7.*

**5.913 Data Processing**

A study of digital computers and computer programming techniques. The FORTRAN language is utilized for programming and running several projects.

**39.9F0 Introduction to Statistics/Mathematics (4 q.h.)**

Data sources, time series analysis, descriptive statistics, hypothesis testing and regression and correlation analysis. Forms and graphical presentation of functions, input-output analysis, the concept of derivatives and potential use in mathematical



analysis. This course carries academic credit for the M.S. degree program but no credit toward the M.A. or Ph.D. program.

### **39.9F1 Seminar In Economic Policy and Planning I (4 q.h.)**

Students are required to participate in a project in their own field of interest, covering such issues as metropolitan and regional job creation policies, budget analysis, evaluation of public programs and the role of private and public sectors in regional development. Techniques for planning such as construction and use of data banks, application of input-output analysis, industrial location analysis and social benefit-cost analysis are covered. The role of agencies in the organization and implementation of programs and plans are examined. *Prep. 39.9A0, 39.9B0, 39.9F0 co-requisite.*

### **39.9F2 Seminar In Economic Policy and Planning II (4 q.h.)**

*Prep. 39.9F1.*

### **39.9G1 Economics of the Labor Market and Labor Force**

Labor force measurement and determinants, changing labor market role of women; micro-analysis of labor supply and demand, varieties of labor markets and their functioning; minimum wages; wage structures and differentials, labor allocation and migration; union impact on wage levels and structures; macro-wage-employment determination, macro-wage-price problems, income policies. Applications to developing and developed economies.

### **39.9G4 Economics of Manpower Planning I**

The role of manpower planning and its integration with general development planning. Analysis and evaluation of different techniques of manpower planning. Technological versus economic methods. Practice of manpower forecasting and data problems. Skill training versus educational strategies. Models of educational planning and their applications to different countries. *Prep. Microeconomic Theory.*

### **39.9G5 Economics of Manpower Planning II**

Applications of manpower planning methods and techniques to problems of national economic development. Cost-benefit and cost-effectiveness of educational and manpower programs. Special problems of health manpower, scientists, engineers, and technicians. Evaluation of methods and prediction used in national manpower plans. *Prep. 39.9G4.*

### **39.9G7 Human Resources and Labor Problems and Policies**

Unemployment and underemployment, technological change and changing skill requirements; income distribution and poverty; human capital theories and human resource development; employment and training policies to raise personal earnings, income maintenance programs. Topics discussed in relation to developing and developed economies.

### **39.9H1 Economics of Medical Care and Health Manpower**

The organization of medical care, the problems associated with various alternative delivery systems, the utilization and availability of physicians and other categories of paramedical personnel, the growth and pressures exerted by third party payers; and consideration of federal, state, and municipal participation in the delivery of quality medical care under various alternatives for national health insurance.

### **39.9H3 Economics of Education**

An examination of the contribution of education to the process of economic growth and the way education is produced and distributed. Special topics to include: inequalities in returns to education; the role of intelligence and class background in educational success; and socializing role of education in production.

### **39.9J1 Seminar In Human Resource Development**

Selected topics on the development and use of human resources. *Prep. Consent of instructor.*

### **39.9K1 Regional Economics**

Delineating regions. Theories of location for firms, industries, and people. Regional income accounting systems, and models of intra- and inter-regional income determinants and impact analysis. *Prep. Microeconomic Theory.*

### **39.9K4 Externalities**

Theoretical foundations for urban and regional economics. Survey of economic theory related to externalities and welfare economics. *Prep. 39.9A1 and consent of instructor.*

### **39.9K5 Economics of Crime**

A discussion of the resource allocation problem as it relates to criminal behavior and effective law enforcement. Evaluation of costs and benefits of alternative law enforcement policies. Criminal activity, including organized crime, will be analyzed in an economic context.

### **39.9L1 Urban Economics I**

The economy of cities. Analysis of intra-metropolitan spatial relationships including residential location, land and housing markets. *Prep. Microeconomic Theory.*

### **39.9L2 Urban Economics II**

Continuation of Urban Economics I. Problems in urban economics including segregation, housing, transportation, urban renewal, and related policy issues. *Prep. 39.9L1.*

### **39.9L5 Economics of Urban Transportation**

Urban agglomeration, economic activities, residential concentration and transportation network; urban and suburban densities in relation to the central place; capital budgeting; pricing; costs incidence and externalities of various modes; cost-benefit analysis; effects of transportation patterns on urban socio-economic life; modal split and forecasting economic requirements for integrated urban transport needs.

### **39.9L7 Economics of Inter-City Transportation**

Investigates the rationale for intercity freight and passenger movements within the framework of interregional commodity flows. The choice of mode once traffic volume has been determined. The economic and environmental impacts of the choice of mode are studied.

### **39.9M1 Intergovernmental Fiscal Relations**

A study of the development of the federal system, interstate and interarea fiscal comparisons, grants-in-aid, tax credits, revenue sharing, state and local taxes, non-tax

revenues, borrowing and budgeting at the state and local level, and a discussion of the process and prospects of state and municipal equalization of tax burden and effort. *Prep. Microeconomic Theory.*

### **39.9N1 Seminar In Urban/Regional Economics**

Selected topics in urban/regional economics. *Prep. Consent of instructor.*

### **39.9P1 Economic Development**

A study of the prospects of economic growth in less developed areas. Measurement and theories of economic development. Role of human and natural resources, education, technology, and capital formation in national, regional, and sectoral development. Changes in institutions.

### **39.9P3 Regional Development.**

Intra-regional dynamics, dualism, and spontaneous polarization. Growth poles, dispersion, and spread effect; inter-regional factor migration and social cost; regional structural change and dynamic analysis; public policies and planning; socio-economic variables and measurements; feasibility and simulation in shortrun analysis. Examples of regions at county, province, state and "area" level; differentiation between political and economic boundaries; bootstrapping vs. outside source approach. Application of the FS and UN multiregional models.

### **39.9P6 Comparative Economic Development**

Comparison of economic systems in differing stages of economic development as exemplified by Yugoslavia, Southern Italy, Turkey, the Middle East, and China.

### **39.9Q1 Development Finance**

Sources of investment finance in developing countries; role of taxation and tax structure reform; development of financial institutions and capital markets; private and official finance from abroad and debt-service problems; problems of monetary management and export instability.

### **39.9R1 Seminar In Development Planning**

Planning techniques at the national, regional project and plan level. Planning for system of regions; interindustry economic programming; interdependence, resource use, and structural change. Application of input-output and linear and non-linear optimal decision techniques to short-run planning and long-run projection. Evaluation of discontinuities, linkages, and "openness." Planning in closed and open economy. The role of the private sector and the governments, limits, sequence, and optimality in planning. Application of techniques to empirical examples. *Prep. Consent of instructor.*

### **39.9S1 Monetary Theory**

A study of the relationships between money and economic activity with emphasis upon various quantity theory models and theories of the demand for money and velocity. *Prep. Macroeconomic Theory.*

### **39.9S3 Monetary Policy**

A study of the interrelationships between aggregate economic activity, financial markets and central banking instruments, objectives and policy.

**39.9T1 Public Policy and Finance**

Techniques of fiscal policy, fiscal policy norms, public sector debt; tax policy; federal tax reform; the conflict between social implications of price stabilization and full employment; public expenditure policy and the interrelationship between monetary and fiscal controls. *Prep. Macroeconomic Theory.*

**39.9T5 Capital Markets**

Primary sources of savings and demand for financial assets; role of financial intermediaries; banking system and government lending agencies. Demand for funds and real investment — mortgage, corporate and government securities markets; interdependence of rate structures. Flow of funds data in relation to national income accounts.

**39.9V1 Seminar in Money, Credit, and Banking.**

Selected topics in the economics of money, credit and banking. *Prep. Consent of instructor.*

**39.9Z1 Master's Thesis Seminar** (maximum 6 q.h.)

Thesis supervision by members of the department; approval of graduate adviser required.

**39.9Z2 Readings in Economics** (up to 3 q.h.)

Supervised reading in selected topics in economics. *Prep. Consent of instructor and approval of graduate adviser.*

**39.9Z5 Doctoral Dissertation Seminar** (no credit)

*Prep. Approval of graduate adviser required.*

# english

Gordon E. Pruett, Ph.D., Acting Chairman

## Professors

Raymond E. Blois, Ph.D.  
Victor E. Howes, Ph.D.  
Samuel French Morse, Ph.D.  
Stanley J. Trachtenberg, Ph.D.  
Arthur J. Weitzman, Ph.D.  
Paul C. Wermuth, Ph.D.

## Associate Professors

Gerald R. Griffin  
Acting Director of  
Graduate Studies  
Samuel J. Bernstein, Ph.D.  
Robert J. Blanch, Ph.D.  
Frank C. Blessington, Ph.D.  
M. X. Lesser, Ph.D.  
James Nagel, Ph.D.  
Jane A. Nelson, Ph.D.  
Robert B. Parker, Ph.D.  
Kinley E. Roby, Ph.D.  
Herbert L. Sussman, Ph.D.

## Assistant Professors

Irene R. Fairley, Ph.D.  
Norma Kroll, Ph.D.  
Joseph E. Westlund, Ph.D.

## THE MASTER'S DEGREE

The Department of English offers a program leading to the M.A. degree. The courses emphasize training in research and criticism in the fields of English and American literature, and they provide the student the comprehensive background necessary for a career as a scholar, teacher, and writer.

## Admission

Applicants are judged favorably if they do superior work in their undergraduate preparation and do significantly better than average in the verbal and advanced sections of the Graduate Record Examination, the scores of which are required before an application will be considered. An applicant is expected to have had at least 24 semester credits in English courses on a 4 point scale. Recommendations should be submitted by former English professors. An applicant who is deficient in any one of these areas may be admitted as a provisional student.

The category of special student is provided for those nondegree students who wish to take a summer course or those already enrolled in a graduate program in another institution who wish to transfer credit. A holder of a graduate degree in English may also enroll as a special student.

## **Program**

Forty-two quarter hours of academic work are required. The course work must include 30.8A1, Bibliography and Literary Historiography, which should be taken as soon as the student enters the program. Required also are three hours from courses in Group II; three hours from courses in Group III; and three hours from courses in Group IV; three hours from courses in Group V (or their equivalents among the seminars); and fifteen hours in designated seminars, which are limited in enrollment to twelve students. The remaining twelve hours may be elected from any courses in the program.

## **Transfer Credit**

A student may transfer from another institution no more than 12 quarter hours (9 semester hours) of graduate credit in English. Within this limit, graduate courses in other fields may also be transferred if their relevance to the student's specialized interest can be demonstrated. In every case, a petition for graduate credit must be sent to the Director of the Graduate School of Arts and Sciences with a copy of an official transcript.

## **Thesis**

A thesis is optional. A student wishing to write a master's paper must secure the approval of a graduate faculty member and write the thesis under the supervision of his adviser. Six credits in lieu of course work are allowed. The student must enroll in 30.9Z1, Thesis, to obtain credit. Papers must conform to the guidelines laid down in the *MLA Style Sheet*.

## **Comprehensive Examination**

A four-hour comprehensive examination is required. It will be given during the Fall and Spring Quarters. Copies of previous examinations are available in the graduate director's office. A student must accrue 30 quarter hours of credit before he is eligible to take the examination. The examination may be taken only twice. As an option, students may choose an oral examination in lieu of the written comprehensive. This must be arranged with the graduate director.

## **Language Requirement**

Normally a degree candidate must pass a reading examination in French or German or Latin. Substitutions must have the approval of the graduate director. Exemption from the examination may be obtained by submitting evidence of having passed with at least a grade of C an *advanced* undergraduate language course carrying six semester credits or eight quarter credits. The examinations will be offered during the Fall and Spring quarters.

## PROGRAM OF ADVANCED LITERARY STUDY

The Department of English offers a program of advanced work in humanistic literary study for those people who already hold the Master's degree. Neither an intermediate step toward a research-oriented Ph.D. nor instruction in pedagogy, the program is designed as "state of the art" training in literary studies. The program is directed toward practitioners in the field as well as those for whom continuing literary study is an end in itself. The program is designed for both full-time and part-time study. Financial aid is available.

### Admission

Applicants must have a Master's degree and are expected to submit transcripts of undergraduate and graduate work.

### Program

Each student will follow an individualized coherent course of study built around his or her own needs and designed in close association with a faculty advisor. The student will develop the outline of this program by the end of the first quarter of work at Northeastern and follow the program, under the supervision of the advisor, throughout his or her work at Northeastern. Forty-two quarter hours of work are needed to complete the program. With permission of the advisor, the student may take up to three graduate courses in any other department.

### Examination

The student must pass an individual comprehensive examination based upon his or her own program of study. The examination will include the evaluation of a lecture/classroom presentation.

## DESCRIPTION OF COURSES

*All courses carry three quarter hours of credit unless otherwise specified.*

### GROUP I

**(three quarter hours required)**

#### 30.8A1 Bibliography and Literary Historiography

Materials and techniques of research in English and American literature; bibliography, form, and content of papers and theses; problems of literary history.

### GROUP II

**(three quarter hours required)**

#### 30.8B1 Theories of Criticism

Modern critical theories including New Critical, psychoanalytic, and Marxist. *Course may not be used to satisfy group requirement.*

**30.8C1 Historical Linguistics I**

Written records; the classification of language; phonetics and phonetic change; the comparative method; dialect geography.

**30.8C2 Historical Linguistics II**

Continuation of 30.8C1. Fluctuation; analogic and semantic change; cultural, intimate, and dialect borrowing. *Prep. 30.8C1.*

**30.8C4 Semantics**

The relation between language and behavior; the concept of change, variety, and uniqueness; symbols; levels of abstraction; habits of evaluation of linguistic phenomena; and modification of such habits in the direction of human adjustment, understanding, and survival.

**30.8C5 History of the English Language I**

The nature and origin of language; ancestry and early growth of English; phonetics, sound-change, and history of English sounds; history of English inflections; sources of the vocabulary; the making of words.

**30.8C6 History of the English Language II**

Semantic change; syntax and usage; dictionaries, spelling, pronunciation, variations, and usage. *Prep. 30.8C5*

**30.8C7 Language and Its Structure**

Introduction to the study of language, the principles and methods of linguistic description; the development of the science of language, of descriptive and generative linguistics. Emphasis on goals of modern linguistic theory.

**30.8D1 Introduction to Old English**

**30.8D6 Chaucer's *Troilus and Criseyde* and Other Poems**

*The Book of the Duchess, The House of Fame, and Troilus and Criseyde*, with a look at *The Romaunt of the Rose*.

**30.8D7 Chaucer's *Canterbury Tales***

**GROUP III**

**(three quarter hours required)**

**30.8E1 Tudor Literature**

Wyatt and Surrey, Sidney, Raleigh, and the beginnings of prose fiction.

**30.8E4 Renaissance Drama**

Twelve representative Elizabethan and Jacobean comedies and tragedies.

**30.8F1 Seventeenth-Century Literature**

Major prose and poetry of the seventeenth-century, excluding drama: Bacon, Hobbes, Browne, Bunyan, Donne, Herbert, Jonson, Marvell, and others.



**GROUP IV****(three quarter hours required)****30.8G1 Restoration and Early Eighteenth Century Literature**

A critical study of neoclassical drama, poetry, and criticism: Restoration drama, Dryden, Pope, Addison, Steele and Gay.

**30.8G6 Age of Johnson**

Johnson, Boswell, and the Club: Burke, Goldsmith, and Gibbon; poetry of Cowper, Gray, Burns, and Smart.

**30.8H1 Romanticism**

General introduction to English Romanticism as an intellectual and artistic movement.

**30.8J1 Victorian Literature**

General survey touching upon major genres of Victorian literature with emphasis on the transition from the Victorian to the "modern." Such writers as Carlyle, Ruskin, the Brontes, Swinburne, Pater, Wilde.

**30.8K1 Twentieth-Century British Literature**

Theme and structure in the work of several dramatists from Shaw to Osborne and of several novelists from Conrad to Anthony Powell with an emphasis on major trends in the novel and in drama during the present century. *Course may not be used to satisfy group requirement.*

**GROUP V****(three quarter hours required)****30.8L1 American Literature to 1830**

A survey of American literature during its first two centuries, from the Puritans to the Knickerbockers, from William Bradford to James Fenimore Cooper.

**30.8M1 Nineteenth-Century American Literature**

A critical examination of selected works of prose and poetry by major writers of the period: Poe, Hawthorne, Melville, Thoreau, Dickinson, and Longfellow.

**30.8N1 Twentieth-Century American Literature**

Chance collisions: Adams, Dreiser, Crane, Dos Passos, Fitzgerald, Cozzens, Faulkner. The beginnings and development of Naturalistic fiction.

**SEMINARS**

**(Fifteen quarter hours of seminar courses are required, of which three credits must be in a pre-nineteenth-century period.)**

**30.9B1 Critical Schools**

The subject of this year's seminar will be structuralism and formalism.

### **30.9B3 English Prose Style**

The development of prose style in English (chiefly expository), from the sixteenth century to the present. Most major authors are represented, from Roger Ascham to James Baldwin.

### **30.9B4 Short Fiction**

The short stories of Sherwood Anderson and Ernest Hemingway and their contribution to American literature.

### **30.9B5 Comic Drama**

The Comic Spirit and its manifestations in dramatic literature and performance. The nature and forms of comic playwriting from Aristophanes to the present. An examination of the theater's comic forms: farce, comedy, satire, parody.

### **30.9B6 Tragic Drama**

This course will consider important theories of tragedy and certain plays in an effort to consider the relation, if any, which exists between theory and practice of the tragic genre.

### **30.9B7 Theatrical Styles**

An examination of modern dramatic expression and theory. The course will give particular attention to absurdist drama, existentialist drama, and Brecht's theatre of alienation.

### **30.9B8 Humor in Literature**

### **30.9B9 Satire**

A theoretical study of satiric forms, Roman, Renaissance and neoclassical verse satire, and later satiric narratives. Writers surveyed: Horace, Juvenal, Pope, Swift, Voltaire, Byron, Evelyn Waugh, etc.

### **30.9C1 Phonetics and Dialectology**

Mastering of the International Phonetic Alphabet (IPA) and of a standard phonemic alphabet; their application to practical work in recording and studying both standard speech and dialects.

### **30.9C2 Descriptive Linguistics**

Intonation (stress, pitch, juncture); phonemics; morphemes and morphology; syntactic devices; the process of communication; variation in speech; etc. *Prep. 30.9C1.*

### **30.9C5 Transformational and Generative Grammar of English**

Deep and surface structures and transformations necessary to generate the latter; graphic representations of structure; deep-structure nature of adjectives, pronouns, prepositions, auxiliaries, possessives, etc.; comparison with traditional grammar.

### **30.9C7 Linguistics and Literary Study**

Language viewed in its special function as literary medium. Linguistic approach to style, metaphor, form and meaning. Representative works of major writers, poetry and prose, studied for characteristic formal properties. Discussion of contribution of linguistic analysis to literary criticism, and to a theory of literature.

**30.9D1 Beowulf**

Prep. 30.8D1

**30.9D2 Old English Poetry**

Prep. 30.8D1

**30.9D5 Middle English Lyrics and Drama**

A study of the epic and romance, concentrating on the transformation of the epic to the courtly hero: works to include in translation *Beowulf*, *Chretien de Troyes*, the *Nibelungenlied*, and *Le Morte D'Arthur*.

**30.9D8 Studies in Fourteenth-Century Literature**

Major works in Middle English including *Sir Gawain and The Green Knight*, *The Pearl*, and *Piers Plowman*.

**30.9E1 Studies in Renaissance Poetry**

Shakespeare, Marlowe, Jonson *et al.*

**30.9E4 Jacobean Drama**

About ten plays, mostly tragedies (except for Jonson); the course presumes a knowledge of Shakespeare's late tragedies and romances.

**30.9E5 Shakespeare's Histories**

The English history plays from *Richard III* to *Henry V*, plus *Titus Andronicus*, *Julius Caesar*, and *Troilus and Cressida*.

**30.9E6 Shakespeare's Tragedies**

Eight Plays from *Richard II* to *Antony and Cleopatra*.

**30.9E7 Shakespeare's Comedies**

Eight plays from *Comedy of Errors* to *The Tempest*.

**30.9E8 Problems of Shakespearean Interpretation**

A study of various "problematic" plays; a general knowledge of Shakespearean drama and the sonnets is presumed.

**30.9F1 Metaphysical Poetry**

Analysis of the structure and texture of poems by Donne, Herbert, and Marvell to determine the distinguishing characteristics of the metaphysical approach to poetry.

**30.9F4 Seventeenth-Century Thought**

Discussion of seventeenth-century theories on science, religion, politics, and art as expressed in Bacon, Burton, Browne, Locke, and Hobbes.

**30.9F6 Milton's Major Poetry**

Milton's poetic and intellectual achievement will be studied by analyzing his major works. Particular emphasis will be given to *Paradise Lost* as an expression of Renaissance humanism and the culmination of the epic tradition.

**30.9G2 Restoration and Eighteenth-Century Drama**

Plays of Etherege, Wycherley, Dryden, Vanburgh, Congreve, Gay, Lillo, Goldsmith, and Sheridan.

**30.9G3 Augustan Literature**

Jonathan Swift and the tradition of satire.

**30.9G5 Eighteenth-Century Thought**

Images of London: ambivalence and satire in urban literature; a survey of novels, essays, plays and poetry treating of life in an urban milieu.

**30.9G7 Eighteenth-Century Fiction**

Novels by Defoe, Fielding, Richardson, Smollett, Sterne and Austen.

**30.9G8 Individual Eighteenth-Century Novelist**

Henry Fielding.

**30.9H1 Romantic Poetry I**

The First Generation: Wordsworth and Coleridge.

**30.9H2 Romantic Poetry II**

The Second Generation: Byron, Keats, and Shelley.

**30.9H3 Problems of Romanticism**

Romantic attitudes towards man in relation to himself, society, and the universe, and romantic attitudes towards individual man as Poet, with the impact these attitudes have upon the form and thematic substance of authentic and fictional autobiography in poetry and prose.

**30.9H8 Individual Romantic Writer**

Blake.

**30.9J1 Early Victorian Poetry**

Close study of Tennyson, Browning, Arnold.

**30.9J2 Late Victorian Poetry**

The Pre-Raphaelite circle, and the movement toward modernism: D. G. Rossetti, Swinburne, G. M. Hopkins.

**30.9J5 Prose of the Victorian Age**

Emphasis on late Victorian period and particularly on the development of prose forms such as utopian literature, fantasy, science-fiction, detective fiction and the imperial adventure story: Morris, Pater, Kipling, Wilde, Wells, Carroll.

**30.9J7 Victorian Novel**

Close study of major works by Dickens, Eliot, the Brontës, Hardy.

**30.9J8 Individual Victorian Novelist**

Recent critical approaches to the novels of Charles Dickens.

**30.9K1 Early Twentieth-Century British Poetry**

Twentieth-century poets whose work has shaped and established the modern tradition, or extended our understanding of the traditions of the past: Hardy, Yeats, Lawrence, Muir, Auden, Owen, Thomas.

**30.9K2 Contemporary British Poetry**

Graves, Larkin, Hughes, *et al.*

**30.9K3 Individual Modern British Poet**

W. H. Auden. A study of Auden's achievement as poet, critic, dramatist, and translator, in the context of his age.

**30.9K4 Twentieth-Century Irish Renaissance**

A study of the emergence of a distinctive Irish literary tradition through concentration on the work of the main figures of the Irish Literary Revival, with particular emphasis on Yeats, Joyce, Synge, and O'Casey; minor concentration will be on post-Revolutionary and contemporary Irish writers: O'Faolain, O'Connor, and Behan.

**30.9K7 Twentieth-Century British Fiction**

Major figures of the modern and the contemporary periods: Conrad, Joyce, Caryl, Beckett, Braine, Fowles, Snow, Lawrence, Woolf, Murdoch, Lessing, Huxley.

**30.9K8 Individual Modern British Novelist**

James Joyce and William Beckett.

**30.9L1 Puritanism**

Edward Taylor and Jonathan Edwards.

**30.9L2 Literature of the New Republic**

The beginning of the American literary tradition in poetry, fiction, and drama, from Freneau to Cooper, 1765-1830.

**30.9M1 Transcendentalism**

From religious or metaphysical idealism to theories of self-transformation, with emphasis on Emerson and Thoreau and consideration of related figures such as Kant, Coleridge, Carlyle, William James, Mumford, Jung.

**30.9M2 Nineteenth-Century American Poetry**

The legacies of Whitman and Dickinson.

**30.9M7 The Romance in America**

An attempt to define American Romance through the study of Cooper's Leatherstocking novels, the major novels of Hawthorne, and Melville's *Moby Dick* and *Billy Budd*.

**30.9M8 The Rise of Realism**

An examination of Local Colorism, Realism, and Naturalism in the works of Twain, Howells, James, Dreiser, Norris, and readings in European Realism.

**30.9N1 Twentieth-Century American Poetry**

Twentieth-century poets who have struggled to establish a tradition for American

poetry and whose examples have dominated poetry up to the present: Robinson, Frost, Stevens, W. C. Williams, M. Moore, Eliot, Pound, Crane, Cummings, and the Fugitives.

**30.9N2 Individual Modern American Poet**

Wallace Stevens.

**30.9N3 Contemporary American Poetry**

Lowell, Bishop, Bronck, Roethke *et al.*

**30.9N7 Modern American Novel**

Comic Resistance: West, Ellison, Mailer, Hawkes, Barth. The exhaustion of possibilities and the post-modern idea of self.

**30.9N8 Individual American Novelist**

Hemingway and Fitzgerald.

**30.9N9 Modern American Drama**

Philosophic and aesthetic trends among such playwrights as O'Neill, Williams, Miller, Albee, Simon, and others.

**30.9P2 Comedy of Disaster in 19th and 20th Century Novels**

**30.9P4 The American 1890s**

Intensive study of the works of Stephen Crane with some attention to other writers of the period, including Howells, Frederic, Garland, and to the cultural milieu.

**30.9P5 Literature of the American South**

A study of the southern literary experience from early nineteenth-century to mid-twentieth, from Simms to Faulkner.

**30.9P8 Art and Literature in the Victorian Period**

Relationships of visual art, literature, and aesthetic theory in the Victorian period. Emphasis on Ruskin, Pre-Raphaelite circle, Pater, Whistler, Wilde.

**30.9P9 Twain and James**

**30.9R1 Creative Writing I**

Prose fiction.

**30.9R2 Creative Writing II**

Prose fiction.

**30.9Z1 Thesis** (maximum: 6 q.h.)

By arrangement.

**30.9Z2 Directed Research**

By arrangement.

# history

## Professors

Raymond H. Robinson, Ph.D.,  
Chairman  
Philip N. Backstrom, Jr., Ph.D.  
Martha E. François, Ph.D.

## Associate Professors

Ballard C. Campbell, Ph.D.  
Norbert L. Fullington, Ph.D.  
Donald M. Jacobs, Ph.D.  
John D. Post, Ph.D.  
Stanley R. Stembridge, Ph.D.

## Assistant Professors

Charmarie J. Blaisdell, Ph.D.  
William M. Fowler, Ph.D.  
Gerald H. Herman, M.A.  
Laverne J. Kuhnke, Ph.D.  
Martin R. Ring, Ph.D.

## THE MASTER'S DEGREE

### Admission

In addition to the admission requirements listed on page 22, applicants must have had a program which includes at least 15 semester hours of history. Applicants for the Fall Quarter who submit their application and all supporting documents by March 15 will be notified on or about April 1. Students who are interested in financial assistance *must* file all material by March 15.

### Program

Forty-two quarter hours of academic work are required. Full-time students take four courses each quarter, thereby completing 36 quarter hours during the Fall, Winter, and Spring Quarters. The remaining credits may be taken during the summer sessions preceding or following the normal academic year.

All students must take the following courses:

23.800 Methodology

either 23.801 European Historiography or 23.900 American Historians

Two courses specifically labeled "seminar." except that students writing theses need take only one seminar.

Students must complete 23.800 prior to enrolling in seminars, and grades of at least B must be obtained in the seminars.

Students must complete at least one course (three quarter hours) in each

of three areas: Group I, Europe; Group II, United States; and Group III, Other Regions.

Group requirements will not be satisfied by the historiography courses, 23.801 and 23.900, or by 23.894, 23.895, 23.896 and 23.898. Courses are identified by group in the course list below.

With the approval of the faculty adviser, a maximum of nine quarter hours may be elected from graduate courses in other departments and a maximum of 12 quarter hours may be elected from advanced undergraduate courses in history.

A thesis is optional with the approval of the chairman of the department. If approved, a thesis carries nine quarter hours of credit.

### **Comprehensive Examination**

All degree candidates must pass a comprehensive examination.

### **Language Requirement**

Proficiency must be demonstrated in a foreign language approved by the department.

### **Financial Aid**

In addition to teaching and tuition assistantships, there is a scholarship in memory of Professor Robert A. Feer, a member of the Department of History from 1963 to 1970.

## **DESCRIPTION OF COURSES**

*All courses carry three quarter hours of credit unless otherwise specified.*

### **23.800 Methodology**

The objectives, methods, and resources of the historian.

### **23.801 European Historiography**

The development of historical writing from ancient times to the present.

### **23.802 Ancient Greece (Group I)**

Selected topics in the history of ancient Greece.

### **23.803 Ancient Rome (Group I)**

Selected topics in the history of Rome in the period of the Republic or the Empire.

### **23.806 Intellectual History of Europe, 1688 - 1789 (Group I)**

The broad spectrum of eighteenth-century thought, with emphasis on scientific religious, and political ideas.

### **23.807 Intellectual History of Europe, 1789-1870 (Group I)**

The great age of liberal and nationalistic thought. Social problems created by industrialism and various proposals to solve these problems will be examined.



**23.808 Intellectual History of Europe, 1870-1950 (Group I)**

The intellectual developments which have brought Europe to its present position in world affairs. Topics considered include theories of evolution, scientism, radical socialism, and fascism.

**23.809 Seminar In European Intellectual History (Group I)**

Research and writing on special topics in European intellectual history.

**23.810 Social History of Europe, 400-1350 (Group I)**

A study of society in the "Age of Faith," with special emphasis on aspirations, way of life, and cultural achievement.

**23.811 Social History of Europe, 1350-1650 (Group I)**

A study of social structure, standards of living, aspirations and frustrations, and cultural achievement in an age of Black Death, Renaissance, and religious controversy.

**23.812 Social History of Europe, 1650 - 1850 (Group I)**

Exploration of social development and cultural achievement in an age of revolutions — intellectual, political, agricultural, and industrial.

**23.813 Economic History of the Modern Western World (Group I)**

Topical analysis of the economic development of the modern western world.

**23.817 Medieval Institutions (Group I)**

Political, economic, and religious institutions in England and France from the fourth to the thirteenth centuries.

**23.818 Seminar In the Renaissance (Group I)**

Research and writing concerning the Renaissance.

**23.819 Seminar In the Reformation (Group I)**

Research and writing concerning the Reformation.

**23.820 The Renaissance (Group I)**

European political and cultural life from the thirteenth to the seventeenth centuries, with attention to Humanism and to the rebirth of classicism in literature and the arts.

**23.821 The Reformation (Group I)**

The development of the Christian Church from the thirteenth to the seventeenth centuries, with attention to the conflict between church and state, the impact of the Renaissance, the rise of the Protestant sects, and the wars of religion.

**23.822 European Urban History to 1750 (Group I)**

A study of urban places from Roman times to 1750 with special consideration of origins; layouts; political, economic, and social life; and the effects of towns on society.

**23.823 European Urban History since 1750 (Group I)**

A study of urban places since 1750 with attention to the growth of population, industrialization, and bureaucratization and attendant problems.

**23.827 Seminar in England, 1558-1660** (Group I)

A study of political, religious, social, and economic problems from Elizabeth I to the Restoration.

**23.830 Britain, 1688-1815** (Group I)

Topics include constitutional evolution, political parties, social and economic change, religious and intellectual developments, cultural achievements, and Scotland and Ireland.

**23.831 Britain, 1815-1914** (Group I)

Aspects of nineteenth-century Britain, including reform of parliament, liberalism and socialism, the Irish question, imperialism, and Victorian ideals and attitudes.

**23.832 Seminar in Twentieth-Century Britain** (Group I)

Selected topics for research and writing.

**23.833 Seminar in Nineteenth-Century Britain** (Group I)

Selected topics for research and writing with special emphasis on the social effects of industrialization.

**23.835 France, 1180-1661** (Group I)

The history of France from the time of Philip II to the majority of Louis XIV with special emphasis on the problems of cultural, political, and economic unity and the effects of the Renaissance and the Reformation.

**23.836 France, 1661-1830** (Group I)

A study of the "Old Regime," including an examination of the reign of Louis XIV, the decline of the French monarchy in the eighteenth century, and the general effects of the Enlightenment; an analysis of the revolutionary period, 1789 to 1830.

**23.840 France and Germany, 1870-1918** (Group I)

Selected comparative topics in the Third French Republic and Wilhelmian Germany.

**23.841 France and Germany since 1918** (Group I)

Selected comparative topics in French and German history since the First World War.

**23.845 Seminar in Nineteenth-Century Europe** (Group I)

Research and writing in European history from 1850 to 1900.

**23.850 Seminar in Russian History** (Group I)

A narrow period or special topic in Russian history. *The course presupposes a basic knowledge of Russian history and will require extensive work on a research paper.*

**23.855 Socialism and Revolution** (Group I)

Studies in the history of socialism and revolution from the early nineteenth-century utopias to the New Left of the 1960s.

**23.860 Diplomatic History of Europe, 1815 - 1914** (Group I)

The foreign policies of the chief European powers, with emphasis on changing alliances and alignments, imperialistic rivalries, and efforts at international cooperation.

**23.861 Seminar In Imperialism (Group I)**

An inquiry into the motives underlying European expansion in the late nineteenth century.

**23.862 Twentieth-Century Europe (Group I)**

The political history of Europe since 1900, with attention to World War I, the rise of Communism and Fascism, the struggle for security in the western democracies, World War II, and the Cold War.

**23.863 Seminar In Twentieth-Century Europe (Group I)**

A study of a selected controversy in contemporary European History.

**23.870 China to 1800 (Group III)**

History of Chinese civilization from antiquity through Confucianism to the period of Western impact.

**23.871 Modern China (Group III)**

Revolution and institutional change in China from the nineteenth century to 1927.

**23.872 Communism In China (Group III)**

A study of the Chinese Communist movement from its origins in the 1920s to the present.

**23.873 Japan to 1600 (Group III)**

A survey of early Japanese history with special emphasis on the social, political, intellectual, and literary history of the medieval period.

**23.874 Japan, 1600 - 1868 (Group III)**

A study of the Tokugawa period, emphasizing the problems of late feudal control, urban and rural developments, social, intellectual, and literary history.

**23.875 Modern Japan (Group III)**

The history of Japan since the fall of the Tokugawa, emphasizing political and economic developments, especially after World War II.

**23.881 Modern Africa (Group III)**

A topical approach to the history of Africa since 1850.

**23.883 History of the Islamic Peoples (Group III)**

A study of the history, culture, and religion of the followers of Muhammad from 600 to 1800.

**23.884 Modern Middle East (Group III)**

A study of the Middle East in the twentieth century.

**23.894 Seminar In History and Media**

Students will explore such topics as the advantages and drawbacks of specific media, the uses and abuses of media in research and teaching, and the construction of media. Each student will participate in a research project involving the creation and/or evaluation of historically valid films, slide tapes, and other materials.

**23.895 Approaches to World History**

An interdisciplinary examination of the study of civilization emphasizing various methodologies and theories and testing them by studying specific historical periods and cultures.

**23.896 Psycho-History**

An introduction to the concepts, scholarship, problems, and directions of psycho-historical studies.

**23.898 Population In History**

An application of demographic theory to history.

**23.900 American Historians**

The writing of American history by Americans from colonial times to the present with emphasis on changes in both form and substance.

**23.901 Recent Interpretations of American History (Group II)**

The literature of American history since 1945.

**23.905 Colonial America: The Seventeenth Century (Group II)**

Exploration of the New World, settlement of the English North American mainland colonies, and the adaptation of European institutions and ideas to New World conditions.

**23.906 Colonial America: The Eighteenth Century (Group II)**

The expansion of the English colonies in the New World, the development of political and social institutions, and the sources of friction with England to 1763.

**23.907 The American Revolution (Group II)**

Topics in the history of the American Revolution from 1763 to 1783.

**23.909 Seminar in Colonial and Revolutionary America (Group II)**

Research and writing on some topic in American history prior to 1789.

**23.910 American Social History, 1607-1815 (Group II)**

The ethnic foundation of American society; the ways Americans made their living, and the ways in which they lived during the colonial and early national periods.

**23.911 American Social History, 1815-1900 (Group II)**

The King Cotton society of the South, the ferment of reform and industrialism in the North, the Civil War, and the materialistic civilization of the late nineteenth century.

**23.912 American Social History, 1900-1950 (Group II)**

The transformation of the naive and idealistic America of the early twentieth century to life in a world in which technology has far outstripped man's mental and moral capacity to cope with it.

**23.920 Seminar in American Urban History (Group II)**

The political, economic, and social history of America's major cities, with special emphasis on Boston's last century.

**23.921 American Social Structure (Group II)**

Survey of population, residential, family, ethnic, and class patterns in American history.

**23.922 American Immigration and Ethnicity (Group II)**

Analysis of immigration to the United States, ethnicity and assimilation, and ethnic group diversity since 1800.

**23.924 Topics in American Reform (Group II)**

Selected studies of movements to change aspects of American Society.

**23.935 Seminar in Recent American History (Group II)**

Special topics from the period 1896 to 1960 will be studied in detail, and students will present a research paper on a major person, action, or movement.

**23.937 American Politics, 1800-1877 (Group II)**

The development of politics and parties in the nineteenth century.

**23.938 American Politics, 1877-1920 (Group II)**

Analysis of political patterns in the "transition" period.

**23.939 Seminar in American Political History (Group II)**

Research and writing on problems in American political history.

**23.940 American Politics since 1920 (Group II)**

Analysis of recent politics, emphasizing the Presidency, voting behavior, and party activity.

**23.941 American Diplomatic History, 1775-1889 (Group II)**

The history of American foreign policy and foreign relations from the American Revolution to 1889.

**23.942 American Diplomatic History since 1889 (Group II)**

The United States in the age of world involvement and responsibility; the imperialistic episode; the world wars; international organizations and alliances.

**23.943 Seminar in American Diplomatic History (Group II)**

Research and writing on selected topics in the history of American foreign relations.

**23.945 Topics in the Civil War and Reconstruction (Group II)**

Analysis of key issues surrounding the events leading up to the Civil War, the war itself, and the Reconstruction period.

**23.962 Archival Administration I**

An introduction to the archival administration with attention to theory and practice of archives and the relation of archives to other historical agencies.

**23.963 Archival Administration II**

Field work experience in archives or other historical agencies under the direction of agency administrators and Northeastern faculty. *Prerequisite* 23.962.

**23.967 Afro-American History I** (Group II)

The history of Afro-Americans to 1900, with emphasis on the role of black people in slavery and freedom.

**23.968 Afro-American History II** (Group II)

The history of Afro-Americans since 1900.

**23.969 Seminar In Afro-American History** (Group II)

Research and writing on some aspect of Afro-American history.

**23.970 The United States and the Caribbean Region** (Group II)

The Caribbean policy of the United States from the Monroe Doctrine to the present.

**23.971 Mexican History** (Group III)

The making of modern Mexico from its Indian and Spanish beginnings to the present.

**23.973 South America to 1900** (Group III)

The European impact on South America, the movements for independence, and the nineteenth-century history of the new republics.

**23.974 South America since 1900** (Group III)

The internal developments of the South American republics and their relations with one another and with other nations in the twentieth century.

**23.975 Seminar In South American History** (Group III)

Research and writing on special topics in the history of the South American republics.

**23.990 Assigned Reading in History** (1 q.h.)

Assigned reading under supervision of a faculty member.

**23.991 Thesis** (9 q.h.)

Thesis supervision by members of the department.

# mathematics

## Professors

David I. Epstein, Ph.D.  
Bohumil CenkI, D.Sc.  
Holland C. Filgo, Jr., Ph.D.  
Arshag Hajian, Ph.D.  
Flavio B. Reis, Ph.D.  
Gabriel Stolzenberg, Ph.D.  
Harold L. Stubbs, Ph.D.  
Jack Warga, Ph.D.

## Associate Professors

Samuel J. Blank, Ph.D.  
Mark Bridger, Ph.D.  
Alberto R. Galmarino, Ph.D.  
Maurice E. Gilmore, Ph.D., Chairman  
Eugene Gover, Ph.D.  
Robert D. Klein, M.S.  
Nancy J. Kopell, Ph.D.  
Richard A. Rasala, Ph.D.  
Thomas O. Sherman, Ph.D.  
Victor R. Staknis, Ph.D.

## Admission

In addition to the admission requirements listed on page 22, applicants should have a background which includes courses in linear and modern algebra and mathematical analysis.

## THE MASTER'S DEGREE

### Full-Time Program

Forty hours of course work are required for the degree. The following courses are required.

#### Credits

10.9A1	Basic Analysis and Topology .....	4
10.9A2	Algebra A .....	4
10.9A3	Integration .....	4
10.9A4	Algebra B .....	4
10.9A5	General Topology .....	4
10.9A6	Complex Variables .....	4
10.9A7	Geometry .....	4

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The remaining 12 credits required for the master's degree may be selected from any graduate mathematics courses with the approval of the student's faculty adviser. In some cases, courses in other departments may be approved.

A full-time candidate for the master's degree will normally take the courses listed above in the first four quarters of graduate study, according to the following schedule:

<b>Fall Quarter</b>	<b>Credits</b>	<b>Winter Quarter</b>	<b>Credits</b>
10.9A1 Basic Analysis and Topology .....	4	10.9A3 Integration .....	4
10.9A2 Algebra A .....	4	10.9A5 General Toplogy .....	4
<b>Spring Quarter</b>	<b>Credits</b>	<b>2nd Fall Quarter</b>	<b>Credits</b>
10.9A4 Algebra B .....	4	10.9A6 Complex Variables .....	4
10.9A7 Geometry .....	4		

### Part-Time Program

Students in this program may progress according to their abilities and the time available. If students are deficient in any of the mathematics courses required for admission to the degree program, they will be required to satisfy their deficiencies by taking courses given for this purpose. Such courses will carry graduate credit, but the credit will be in addition to the regular degree requirements. The following courses are required:

	<b>Total Credits</b>
10.8C1 General Topology I .....	2
10.8D1, 10.8D2 Theory of Functions of a Real Variable I, II .....	4
10.8J1, 10.8J2, 10.8J3 Theory of Functions of a Complex Variable I, II, III .....	6
10.8P1, 10.8P2, Algebra I, II .....	4
	<hr/> 16

The remaining 24 quarter hours may be selected from graduate mathematics courses. With the approval of the department, a maximum of 10 of these elective credits may be selected from courses in other departments in the Graduate School of Arts and Sciences or the Graduate School of Engineering.

### Other Requirements

There is no comprehensive examination and no language requirement for the master's degree. A thesis is not required but may in some cases be substituted for an elective course with the approval of the department.



## THE DOCTOR OF PHILOSOPHY DEGREE

### Admission

Students who have completed the first year of the full-time master's degree program or who have obtained a master's degree at another institution are eligible for admission to the doctoral program. Students who wish to earn the doctor's degree should inform the chairman of the graduate committee of their desire to be doctoral candidates. Those who have been accepted as doctoral candidates will remain in that category as long as their progress is deemed satisfactory.

### Residence Requirement

The residence requirement is satisfied by one year of full-time graduate work.

### Degree Candidacy

Degree candidacy is established in accordance with the general graduate school regulations.

### Course Requirements

The course requirements, in addition to the minimum master's degree requirements of 40 quarter hours of credit, are established by the departmental graduate committee for each candidate. In most cases, 40 quarter hours of additional work will be required.

### Independent Work

Before starting their dissertation, doctoral students may be required to do some kind of independent project, possibly, but not necessarily, in conjunction with departmental seminars or courses. The aim of the project is to start students on independent work and to give them a practical way to learn research techniques. Students should, with the help of their advisers, choose a topic they want to investigate. In studying it, students should read texts and journal articles and learn what to read and what not to read. In addition, they should try to solve problems, compute examples, modify proofs, and see whether or not the known results can be extended. Students should report on their work either in seminars or by giving a special lecture or writing up a short paper.

### Minor Specialty

Each doctoral candidate will select some specific mathematical subject of an advanced nature, which must be reasonably unrelated to the topic of the student's dissertation. By means of reading, lecture courses, and/or seminars, the student should render work in this area equivalent to a good part of one full year's course work. Approval of the area and the plan of work should be obtained in advance from the Ph.D. committee.

### Language Requirements

Ability to read and translate mathematical texts and journals in two foreign languages must be established by each candidate. The languages may be chosen from French, German, and Russian; any other choice requires special approval. The students should notify the chairman of the departmental graduate committee when they are prepared to be examined on each language. At least one language examination must be passed before beginning work on the dissertation. The examinations are conducted by members of the faculty of the mathematics department.

### Teaching Requirement

Some teaching experience is required. This requirement may be satisfied by at least one year of service as a teaching assistant or by suitable teaching duties.

### Dissertation

After the successful completion of their independent work when required, students shall select a dissertation adviser under whose guidance they will write their doctoral dissertation. They may be assisted by the departmental graduate committee in that selection if they wish it. The dissertation itself must represent an original solution of a problem in the chosen area of mathematics which makes some contribution to mathematical knowledge.

### Final Oral Examination

This examination on the dissertation will be held in accordance with the graduate school regulations.

## DESCRIPTION OF COURSES

*The following courses are offered for those who wish to enter the master's degree program in mathematics, but who fail to satisfy the admission requirements in algebra and/or analysis. These courses will be taken in addition to the required course work in mathematics.*

#### **10.8B1, 10.8B2, 10.8B3 Abstract Algebra I, II, III (2 q.h.)**

Groups, subgroups, normal subgroups, rings, ideals, integral domains, and fields. *Prep. Differential and Integral Calculus.*

#### **10.8B4 Advanced Calculus I (2 q.h.)**

Functions of one independent variable; limits, continuity, differentiability. Properties of continuous functions on a closed bounded interval. Rolle's theorem and the mean-value theorem. *Prep. Differential and Integral Calculus.*

#### **10.8B5 Advanced Calculus II (2 q.h.)**

Functions of several independent variables. Distance and open sets; limits, continui-

ty. Properties of continuous functions on a closed bounded set. Differentiability and differentials, mean-value theorem, implicit function theorems, Jacobians and transformations. *Prep. 10.8B4.*

**10.8B6 Advanced Calculus III (2 q.h.)**

Sequences, sequences of functions, uniform convergence, series. Integration, line and surface integrals. *Prep. 10.8B5.*

*The following courses may be used toward the degree requirements in mathematics.*

**10.8C1, 10.8C2 General Topology I, II (2 q.h.)**

Sets and maps, metric spaces, topological spaces, separation axioms, compactness, connectedness. *Prep. 10.8B6 or equivalent.*

**10.8D1 Theory of Functions of a Real Variable I (2 q.h.)**

Lebesgue measure on real line, measurable functions, Lebesgue integral, convergence theorems, bounded variation, absolute continuity. *Prep. 10.8C1.*

**10.8D2 Theory of Functions of a Real Variable II (2 q.h.)**

Classical Banach spaces, integration theory on abstract measure spaces, signed measures, Radon-Nikodym theorem, product measure, Fubini theorem. *Prep. 10.8D1.*

**10.8E1 Advanced Differential Equations I (2 q.h.)**

First order differential equation; existence and uniqueness theorems; dependence of solution on parameter. Stability theory. Periodic solutions. *Prep. 10.8B6.*

**10.8E2 Advanced Differential Equations II (2 q.h.)**

Systems of first order differential equations. *Prep. 10.8E1.*

**10.8E3 Advanced Differential Equations III (2 q.h.)**

Selected topics, including asymptotic behavior of solutions. *Prep. 10.8E2.*

**10.8E4 Partial Differential Equations I (2 q.h.)**

Partial differential equations of first order; Cauchy-problem; Cauchy-Kowalewski theorem. Method of characteristics. *Prep. 10.8B6.*

**10.8E5 Partial Differential Equations II (2 q.h.)**

Classification of second order equations. Well-posed problems. Emphasis on hyperbolic equations. *Prep. 10.8E4.*

**10.8E6 Partial Differential Equations III (2 q.h.)**

Emphasis on elliptic equations. *Prep. 10.8E5.*

**10.8E8, 10.8E9 Integral Equations I, II (2 q.h.)**

Equations of Volterra and Fredholm. Symmetric kernels. Orthogonal systems of functions. Applications. *Prep. 10.8B6 or equivalent.*

**10.8F1 Difference Equations (2 q.h.)**

Formulation and solution of difference equations; approximate solution of engineer-

ing problems by finite-difference methods; relaxation techniques; stability and convergence of approximate methods; applications. *Prep. 10.8B6 or equivalent.*

**10.8F3, 10.8F4 Calculus of Variations I, II (2 q.h.)**

The concept of the first variation of a functional; the simplest variational problem; Euler's equation. Generalization to several variables. Hamilton-Jacobi theory. Sufficient conditions for extrema. Fields of extremals. Direct methods in variational problems. *Prep. 10.8B6.*

**10.8G1 Probability I (2 q.h.)**

Fundamentals of probability theory; discrete and continuous probability distributions, including binomial, Poisson, and normal; law of large numbers and central limit theorem. *Prep. Differential and Integral Calculus.*

**10.8G2 Probability II (2 q.h.)**

Further study of probability distributions for one or more random variables. Special topics such as counting processes and Markov chains. *Prep. 10.8G1.*

**10.8G4 Mathematical Statistics I (2 q.h.)**

Fundamental statistical methods. Tests of significance and estimation based on large or small samples; simple correlation and linear regression. *Prep. 10.8G1 or equivalent.*

**10.8G5 Mathematics Statistics II (2 q.h.)**

Further topics in statistical inference, including analysis of variance. *Prep. 10.8G4.*

**10.8G8 Stochastic Processes (2 q.h.)**

Processes with independent increments. Strict and wide sense stationary processes. Markov processes. Renewal processes. Queuing problems. *Prep. 10.8G2.*

**10.8H4 Statistical Decision Theory (2 q.h.)**

Subjective Probability. Utility. Bayesian approach to statistical decision problems. *Prep. 10.8G1 or 10.8G4.*

**10.8J1 Theory of Functions of a Complex Variable I (2 q.h.)**

Geometry of the complex plane, analytic functions, Cauchy's theorem. *Prep. 10.8C1 (may be taken concurrently).*

**10.8J2 Theory of Functions of a Complex Variable II (2 q.h.)**

Infinite sequences and series, singularities, residues, applications. *Prep. 10.8J1.*

**10.8J3 Theory of Functions of a Complex Variable III (2 q.h.)**

Meromorphic functions, Mittag-Leffler theorem, conformal mapping. *Prep. 10.8J2.*

**10.8K1 Fundamental Questions of Mathematics: An Introduction to Mathematical Logic (2 q.h.)**

A discussion of truth tables, propositional calculus with applications, theories and models, and Godel's incompleteness results. The course stresses the way in which Mathematical Logic raises and solves problems in number theory, set theory, analysis, and geometry. *Prep. none.*

**10.8K2 A First Course In Mathematical Logic** (2 q.h.)

Propositional calculus, quantificational logic, first order theories through the Skolem-Lowenheim Theorem. *Prep. none.*

**10.8K3 An Introduction to Recursive Function Theory** (2 q.h.)

Turing machines. Partially computable functions. Primitive recursive and general recursive functions and predicates. Unsolvability of decision problems. Recursively enumerable sets of integers. The unsolvability of Hilbert's Tenth Problem. *Prep. none.*

**10.8K4 Godel's Incompleteness Theorems** (2 q.h.)

Formal number theory. Arithmetization. Godel's First and Second Incompleteness Theorems for formal number theory. *Prep. a knowledge of the methods of mathematical logic.*

**10.8K5 Set Theory** (2 q.h.)

The informal study of sets, including detailed discussion of the axiom of choice, well-ordered sets, and transfinite arithmetic. *Prep. none.*

**10.8K6 Formal Set Theory** (2 q.h.)

Versions of axiomatic set theory. The consistency of the continuum hypothesis and the axiom of choice. As time permits, the independence of the continuum hypothesis and the axiom of choice. *Prep. the equivalent of 10.8K2 and 10.8K5.*

**10.8L1, 10.8L2 Numerical Analysis I, II**

Solutions of algebraic and transcendental equations. Approximation and interpolation. *Prep. 10.8B6 or equivalent.*

**10.8P1, 10.8P2, 10.8P3 Algebra I, II, III** (2 q.h.)

The content of these courses is the same as 10.9A2 and the first part of 10.9A4. *Prep. 10.8B2 or equivalent.*

**10.8T1, 10.8T2 Matrix Analysis I, II** (2 q.h. each)

Solutions of systems of linear equations; matrix inversion, characteristic values, canonical forms. Hermitian, orthogonal and unitary matrices. Matrix calculus. *Prep. 10.8B6 or equiv.*

**10.8T3 Tensor Analysis I** (2 q.h.)

Tensor algebra; review of three-dimensional point and vector spaces in the setting of tensor analysis. Linear algebra and n-dimensional affine space. The coordinate tensor, tensor products, invariants, physical components. *Prep. 10.8B6 or equivalent.*

**10.9A1 Basic Analysis and Topology** (4 q.h.)

Sets and functions. Metric spaces with examples. Continuous functions. Notions of compact, complete, paracompact spaces. Function spaces, especially Banach and Hilbert spaces. Multilinear maps. Coordinate-free calculus, inverse and implicit function theorems, Taylor formula, first-order differential equations.

**10.9A2 Algebra A** (4 q.h.)

Groups, rings, modules: basic properties and examples. Linear algebra from an advanced standpoint; exactness and techniques of ring theory. Free groups, generators

and relations, finitely generated abelian groups, Sylow theorems. Other topics as time permits.

#### **10.9A3 Integration (4 q.h.)**

Measure spaces. Abstract Lebesgue integral. Convergence theorems. Construction of Lebesgue measure on  $\mathbb{R}^n$ . Radon-Nikodym theorem. Product measure theorem. Fubini's theorem.

#### **10.9A4 Algebra B (4 q.h.)**

Polynomial functions and formal polynomials. Polynomial rings and unique factorization. Construction of extension fields. Splitting fields of polynomials. Theory of fields and Galois theory. Examples.

#### **10.9A5 General Topology (4 q.h.)**

General topological spaces. Moore-Smith convergence. Compactness and connectedness. Separation properties. Products, Quotient spaces. Inductive and projective limits. Function spaces. Elementary homotopy. Some of the functorial viewpoint.

#### **10.9A6 Complex Variables (4 q.h.)**

Elementary properties of holomorphic functions, harmonic functions, maximum modulus principle, approximation theorems, conformal maps, zeroes of holomorphic functions, analytic continuation.

#### **10.9A7 Geometry (4 q.h.)**

Fundamental group, covering spaces, simplicial complexes, manifolds, orientation, linear group manifolds. Some attempt to tie up algebra and topology.

#### **10.9B3 Constructive Algebra (4 q.h.)**

A constructive development of some of the old familiar areas of algebra: principal ideal domains, Dedekind domains, factorial domains, Noetherian rings.

#### **10.9B7, 10.9B8 Philosophy of Science & Mathematics I, II (4 q.h. each)**

Topics may vary from year to year. Past subjects have included the foundations of statistical inference, the structure of scientific theories and an analysis of the conceptual structure of mathematics.

#### **10.9B9 Seminar: Constructive Mathematics (4 q.h.)**

#### **10.9C1, 10.9C2 Functional Analysis A, B (4 q.h.)**

Topological vector spaces, Banach spaces, Hilbert spaces, algebras of operators, representations.

#### **10.9E1 Advanced Differential Equations (4 q.h.)**

The Material of 10.8E1 and 10.8E2 is covered as a unit in 10.9E1. *Prep. 10.9A1.*

#### **10.9E3, 10.9E4 Partial Differential Equations A, B (4 q.h.)**

Treats a selection of the material of 10.8E4, 10.8E5 and 10.8E6. *Prep. 10.9A1 and 10.9A6.*

#### **10.9E6 Integral Equations (4 q.h.)**

Covers material from 10.8E8, 10.8E9. *Prep. 10.9A1.*

**10.9F1 Optimal Control Theory A** (4 q.h.)

Analytical preliminaries (special theorems on measure and integration, differentiation in Banach spaces, differential equations, convex sets, representation of special linear functionals, etc). Relaxed controls and the existence of optimal relaxed solutions and approximate solutions. Necessary conditions for minimum with and without unilateral restrictions for problems defined by ordinary differential equations. *Prep. 10.9A1, 10.9A3.*

**10.9F2 Optimal Control Theory B** (4 q.h.)

Selected topics such as problems with minimax controls, necessary conditions for optimal unrelaxed solutions, problems with unbounded controls, problems defined by functional-integral equations, necessary conditions without differentiability assumptions. *Prep. 10.9F1.*

**10.9G1 Probability** (4 q.h.)

Probability spaces. Probability laws of families of random variables. Distribution functions and characteristics functions on  $\mathbb{R}^n$ . Strong limit laws of sums of independent random variables. Central limit theorem. Conditional expectations.

**10.9H1 Mathematical Statistics** (4 q.h.)

This course embodies the material in 10.8G4 and 10.8G5. *Prep. 10.8G1 or equivalent.*

**10.9M5, 10.9M6 Lie Groups and Fourier Theory A, B** (4 q.h.)

Certain questions in analysis take on a special simplicity due to the benevolent presence of an algebraic structure. Starting with simple classical examples, the course will work toward a deeper and more contemporary vision of Lie groups and Fourier theory. Ideas will outweigh proofs.

**10.9N1 Advanced Mathematics A** (4 q.h.)

Legendre and Bessel functions, Laplace transforms, Fourier integrals, boundary-value problems, introduction to matrix algebra. *Prep. Differential Equations. Not to be used for credit toward the program in mathematics.*

**10.9N2 Advanced Mathematics B** (4 q.h.)

This course embodies the material in 10.8A3 and 10.8A4. *Prep. 10.9N1. Not to be used for credit toward the program in mathematics.*

**10.9P0 Seminar: Classical Groups** (up to 4 q.h.)

Topics in classical groups as chosen by participants.

**10.9P1 Representations of Groups** (4 q.h.)

A basic course in group representations and character theory.

**10.9Q1 Homological Algebra** (4 q.h.)

Maps, sums, tensor products, exact sequences, homology, derived functors and adjoints, applications to algebra and topology.

**10.9Q2 Module Theory** (4 q.h.)

Techniques of commutative and homological algebra applied to modules and ideals. Applications to regular and Gorenstein rings.

**10.9Q6 Ring Theory** (4 q.h.)

A survey of ring theory. Commutative algebra and its geometric significance. Ideal and decomposition theory, semi-simple rings. Additional topics to be decided upon.

**10.9U1, 10.9U2 Algebraic Topology A, B** (4 q.h.)

Topics from: Homology groups, homology sequences, fiber spaces, sheaves, products in homology and cohomology, cohomology algebra, Kunneth theorems, Steenrod operations, Poincare duality, higher homotopy groups and the Hurewicz theorem, characteristic classes.

**10.9W1, 10.9W2 Dynamical Systems A, B** (4 q.h.)

Structural stability and qualitative theory of dynamical systems.

**10.9W9 Seminar: Dynamical Systems** (up to 4 q.h.)

Topics in dynamical systems as chosen by participants.

**10.9Z1 Master's Thesis** (up to 6 q.h.)

**10.9Z2 Readings in Analysis** (up to 4 q.h. per quarter)

**10.9Z3 Readings in Algebra** (up to 4 q.h. per quarter)

**10.9Z4 Readings in Topology** (up to 4 q.h. per quarter)

**10.9Z5 Doctoral Dissertation**

**10.9Z6 Seminar in Analysis** (up to 4 q.h. per quarter)

**10.9Z7 Seminar in Algebra** (up to 4 q.h. per quarter)

**10.9Z8 Seminar in Topology** (up to 4 q.h. per quarter)



# physics

## Professors

Roy Weinstein, Ph.D.  
Chairman  
Ronald Aaron, Ph.D.  
Petros N. Argyres, Ph.D.  
Richard L. Arnowitt, Ph.D.  
Alan H. Cromer, Ph.D.  
Marvin H. Friedman, Ph.D.  
David A. Garelick, Ph.D.  
Marvin W. Gettner, Ph.D.  
Michael J. Glaubman, Ph.D.  
Hyman Goldberg, Ph.D.  
Bernard Gottschalk, Ph.D.  
Walter Hauser, Ph.D.  
Giovanni Lanza, Ph.D.  
Bertram J. Malenka, Ph.D.  
Pran Nath, Ph.D.  
Clive H. Perry, Ph.D.  
Eugene J. Saletan, Ph.D.  
Carl A. Shiffman, Ph.D.  
Yogi N. Srivastava, Ph.D.  
Michael T. Vaughn, Ph.D.  
Eberhard von Goeler, Ph.D.  
Thomas H. Wallace, Ph.D.  
Fa-Yueh Wu, Ph.D.

## Associate Professors

Evangelos M. Anastassakis, Ph.D.  
Robert I. Boughton, Ph.D.  
William L. Faissler, Ph.D.  
Robert P. Lowndes, Ph.D.  
James E. Neighbor, Ph.D.  
Jeffrey B. Sokoloff, Ph.D.  
Allan Widom, Ph.D.

## Assistant Professors

Arun Bansil, Ph.D.

## Research Associates

Paul S. Gauthier, Ph.D.  
Ronald S. Longacre, Ph.D.  
Michael L. Mallery, Ph.D.  
Douglas M. Potter, Ph.D.  
Giulia Srivastava, Ph.D.  
Neal E. Tornberg, Ph.D.

## Admission

Applicants for admission must have had, in addition to the requirements of the college, an undergraduate program which includes at least 12 semester hours of upperclass physics (beyond general physics) and courses in calculus and ordinary differential equations.

Students planning to enter graduate school should have in their upper-class undergraduate program the following courses or their equivalent:

- 11.200 - 11.201 Mechanics
- 11.211 - 11.212 Electricity and Magnetism
- 11.220 - 11.230 Thermodynamics, Kinetic Theory and Modern Physics
- 11.240 - 11.241 Quantum Mechanics

plus courses in advanced calculus, functions of a complex variable, fourier series and boundary value problems. (The numbers correspond to Northeastern courses which are listed among the introductory courses below.) Students whose background in one or more of these areas is weak will be asked to satisfy the prerequisites to the required courses by taking up to 9 q.h. of introductory courses.

All students admitted to the program must be interviewed by the department and arrangements for a program of study must be concluded before

registration. Appointments may be made in advance (though this is not usually necessary during regular office hours) by writing or calling the department [tel. (617) 437-2902].

### The Program

There exists only one graduate program in the department, though some of our students are full-time, some are part-time, some leave with the M.S. and some continue on to the Ph.D.

The department is very active in research as evidenced by a publication rate of over 50 journal articles per year, a research support level of close to \$1 million per year, and an internationally established reputation in experimental and theoretical high energy (particle) and solid state physics. The research done in the department is basic research of high quality, and is of significance to the fundamental development of physics.

## THE MASTER OF SCIENCE DEGREE

### Course Requirements

Forty-two quarter hours (q.h.) of graduate credit are required, of which up to 12 q.h. may be transfer credit on departmental approval, and up to 9 q.h. may be in introductory courses.

The following courses are required, for a total of 30 q.h. of graduate credit:

11:820*, 11.825	Mathematical Methods A,B,	(3 q.h.)
11.824, 11.826	Classical Mechanics A,B,	(3 q.h.)
11.834, 11.835, 11.836*	Electromagnetic Theory A,B,C	(3 q.h.)
11.841, 11.842, 11.843	Quantum Theory A,B,C	(4 q.h.)

\*NOTE: Only one of these two courses is *required* for the M.S.

Students may take as electives any courses carrying graduate credit in physics, mathematics, engineering, chemistry, psychology, or biology, for which the student has adequate preparation.

Detailed course descriptions are listed below.

### Sample Programs for Part-time Students

YEAR	F	W	Sp	F	W	Sp	F	W	Sp
I	11.820	11.211	11.212	11.820	11.240	11.241†	11.820†	11.825	11.826 11.824
II	11.824	11.825	11.826	11.824	11.825	11.826	11.834	11.835	11.836
III	11.834	11.835	11.836†	11.834	11.835	11.836†	11.841	11.842	11.843†
		11.240			11.285†				
IV	11.841	11.842	11.843	11.841	11.842	11.843	11.827†	11.828†	11.829†

†Electives

## THE DOCTOR OF PHILOSOPHY DEGREE

### Admission

A student's eligibility to take the Ph.D. qualifying examination is decided by a committee of the department on the basis of the student's overall performance. Full-time students will be notified of their status sometime in their second year of study. Students enrolled in the part-time master's degree program who wish to qualify for Ph.D. candidacy may so indicate by petition to the graduate committee of the department. The petition should include a timetable for completing the additional 33 (30 if he has had 11.836) quarter hours of required courses listed below and for taking the qualifying examination.

### Course Requirements

The following courses are required in addition to the required courses for the M.S. degree:

11.827, 11.828, 11.829	Statistical Physics, A,B,C	(3 q.h.)
11.836	Electromagnetic Theory C	(3 q.h.)
11.848	Advanced Quantum Theory	(4 q.h.)
11.86A, 11.86B, 11.86C	Particle and Nuclear Physics A, B, C	(3 q.h.)
11.87A, 11.87B	Solid State Physics A,B	(4 q.h.)

Notice that while these courses add up to 33 q.h., 12 q.h. of the total may have been taken for the M.S., leaving only 21 q.h. of additional required courses for the Ph.D.

### Sample Programs for Full-Time Ph.D. Students

YEAR	F	W	Sp	F	W	SP	F	W	SP
I	11.820	11.211	11.212	11.820	11.240	11.241	11.824	11.825	11.826
	11.824	11.825	11.826	11.824	11.825	11.826	11.834	11.835	11.836
	11.240	11.285†	11.241	11.834	11.835	11.836	11.841	11.842	11.843
II	11.834	11.835	11.836	11.841	11.842	11.843	11.827	11.828	11.829
	11.841	11.842	11.843	11.827	11.828	11.829	11.848	11.87A	11.87B
	11.827	11.828	11.829	<b>Electives</b>			11.86A	11.86B	11.86C
							<b>Qualifying Exam</b>		
III	11.848	11.87A	11.87B	11.848	11.87A	11.87B	<b>Thesis Research and Advanced Electives</b>		
	11.86A	11.86B	11.86C	11.86A	11.86B	11.86C			
	<b>Electives</b>			<b>Electives</b>					
	<b>Qualifying Exam</b>			<b>Qualifying Exam</b>					

### IV, V Thesis Research and Advanced Electives

†Suggested electives.

**Qualifying Examination**

The qualifying examination consists of a written and an oral part. The written examination covers the material in the required courses for the Ph.D. program. This examination is given twice a year, once in September and once in February. A student must take this examination during the next Fall Quarter following the quarter in which he became eligible to take it. If the examination is failed, it may be repeated for the second and last time on the next occasion it is given.

**Residence Requirement**

After a student has completed the required 63 q.h. (60 q.h. for students exempted from 11.820) of course work and has passed his qualifying examination, he becomes a doctoral degree candidate and must satisfy the residence requirement by one year of full-time graduate work.

**Teaching Requirement**

Some teaching experience is required. This requirement may be satisfied by at least one year of service as a teaching assistant or by suitable teaching duties.

**Dissertation**

The student should arrange for a dissertation adviser by the time he wishes to take the oral part of the qualifying examination. An outline of the dissertation must be approved by the departmental graduate committee at least eight months before the final dissertation examination (see below).

The student may choose his field of research according to one of the following options:

- a) In one of the research areas in the department, under direct supervision of his adviser.
- b) In one of the other research areas of the University, under the direct supervision of a researcher in that field. In that case, a joint committee including his direct supervisor, his departmental adviser, and one other member of the department will constitute his thesis committee.
- c) In an area of applied research in one of the industries or non-profit institutions associated with the department's Industrial Ph.D. Program. His direct supervisor will be an employee of the institution where their research is done (and will have been accredited by the physics department); the rest of the thesis committee will be as in option (b) above.

**Final Dissertation Examination**

This examination will be held in accordance with the graduate school regulations.

## DESCRIPTION OF COURSES

### I. INTRODUCTORY COURSES

#### 11.200 **Mechanics I** (3 q.h.)

Vector analysis. Kinematics and dynamics of particle motion, generalized coordinates and Lagrange's equations of motion. *Prep. Basic Physics and Differential Equations.*

#### 11.201 **Mechanics II** (3 q.h.)

Conservation theorems, central force motion, systems of particles, rigid body motion, Hamilton's equations. *Prep. 11.200.*

#### 11.208 **Introduction to Mathematical Physics**

Review of linear algebra and vector calculus, special functions and partial differential equations of physics, potential theory, functions of a complex variable. *Prep. Differential Equations.*

#### 11.211\*, 11.212\* **Electricity and Magnetism I, II** (3 q.h.)

A two-quarter sequence in electromagnetic theory, Maxwell's equations and their experimental basis, electrostatics and magnetostatics, the electromagnetic field in empty space, electromagnetic waves, energy and momentum in the electromagnetic field, electrodynamics, the interaction of matter and the field, radiation. *Prep. 11.208.*

#### 11.230 **Modern Physics** (3 q.h.)

A review of experiments demonstrating the atomic nature of matter, the properties of the electron, the nuclear atom, the wave-particle duality, spin, and the properties of elementary particles. The course discusses, mostly on a phenomenological level, such subjects as atomic and nuclear structure, properties of the solid state, and elementary particles. *Prep. 11.200*

#### 11.240\* **Quantum Mechanics I** (3 q.h.)

The first of a two-quarter sequence in quantum mechanics. Observations of macroscopic and microscopic bodies. The uncertainty principle, wave particle duality, probability amplitudes, Schrodinger wave theory, and one-dimensional problems. *Prep. 11.208.*

#### 11.241\* **Quantum Mechanics II** (3 q.h.)

Continuation of 11.240. Discrete and continuous states, Schrodinger equation in three dimensions, angular momentum, general theory of quantum mechanics, application. *Prep. 11.240.*

#### 11.285\* **Introduction to Nuclear Physics** (3 q.h.)

Nuclear structure, nuclear masses, radioactivity, nuclear radiation, interaction of radiation and matter, detectors, fission, nuclear forces, elementary particles. *Prep. 11.230.*

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\*These courses meet twice a week in the late afternoon and evening for 2 hours each time. The others usually meet 3 times a week in the day (except for 11.871, 11.872).

**11.846, 11.847 Electronics and Data Analysis I, II (4 q.h.)**

A two-quarter course intended to teach those electronic and data-analysis techniques that are common to research in all fields of experimental physics. Subjects in electronics will be: principles of semiconductor devices; analog techniques including feedback and servo loops, and wide-band amplification; digital techniques including integrated circuits and logic techniques; design of electronic subsystems such as counters, analog-to-digital converters and phase-sensitive detectors. Subjects in data analysis will be probability theory; distribution functions; fitting data with a hypothesis; error estimation. Time permitting, high-vacuum techniques, cryogenic techniques, and lasers may also be covered.

**11.871 Radiation Physics (2 q.h.)**

Introduction to atomic and nuclear physics for graduate students in biology and pharmacy. Topics include quantum mechanics and atomic structure, nuclear structure, radioactivity, properties of nuclear radiation, detection of radiation.

**11.872 Radiation Biology and Health Physics (2 q.h.)**

The effects of radiation on biological systems and the uses of radiation in medicine and biological research. Topics include dosimetry, effects of radiation on chemical reactions; effects of radiation on cells, organs, and individuals; theories of radiation damage; imaging and tracer techniques using radiopharmaceuticals; radiation safety and standards. *Prep. 11.871.*

**II. REQUIRED REGULAR COURSES (Offered every year)****11.820 Mathematical Methods A (3 q.h.)**

Theory of functions of complex variable. Analytic functions. Taylor and Laurent infinite series. Analytic continuation and classification of functions. Calculus of residues. Asymptotic series. Applications to ordinary differential equations and the study of special functions.

**11.825 Mathematical Methods B (3 q.h.)**

Finite dimensional linear vector spaces. Matrices and determinants. Function spaces, Hilbert space and Hermitian forms. Linear integral equations. Completely continuous operators. Generalized Fourier expansions generated by solutions of the Sturm-Liouville problem. Linear response theory. Green's functions. *Prep. 11.820 or equivalent.*

**11.824 Classical Mechanics A (3 q.h.)**

Newton's law. Central force motion. Constraints and generalized coordinates. Lagrangian formulation. Hamilton's variational principle. Transformation symmetries. Small oscillations and normal modes. Scattering theory and cross-sections.

**11.826 Classical Mechanics B (3 q.h.)**

Rigid body motion. Hamiltonian formulation. Poisson brackets and canonical transformations. Hamilton-Jacobi theory. Lagrangian and Hamiltonian formalisms of continuous media and fields. *Prep. 11.824.*

**11.827 Statistical Physics A (3 q.h.)**

The phenomenological theory of thermodynamics. Fundamental relations and thermodynamic potentials. Extremal principles of thermodynamics. Applications to simple systems. Stability conditions. Phase transitions. Thermodynamics of electric and

magnetic systems. Principles of irreversible thermodynamics. *Prep. 11.824; and 11.841 concurrently.*

**11.828, 11.829 Statistical Physics B, C (3 q.h.)**

The principles of statistical mechanics and statistical thermodynamics. Density matrix. Theory of ensembles. Derivation of the laws of thermodynamics. Fermi-Dirac and Bose-Einstein statistics. Application to gases, liquids, and solids. Theory of phase transitions. Second-quantization formalism for interacting systems. Co-operative phenomena. *Prep. 11.827, 11.841.*

**11.834, 11.835, 11.836 Electromagnetic Theory A, B, C (3 q.h.)**

Maxwell's equations. Static field and boundary value problems; multipole expansion. Phenomenology of dielectrics, conductors, and magnetic materials. Faraday's Law. Energy and momentum; Poynting vector; Maxwell stress tensor. Plane waves; polarization. Reflection and refraction; diffraction. Relativity. Radiation from sources. Motion of charged particles in electromagnetic fields; magnetic mirrors, particle accelerators. Introduction to plasma physics; magnetohydrodynamics. Radiation from accelerated charges; bremsstrahlung, synchrotron radiation. Scattering of radiation; interaction of radiation with matter. *Prep. 11.212, 11.820 (concurrently).*

**11.841, 11.842, 11.843 Quantum Theory A, B, C (4 q.h.)**

Experimental basis of quantum theory. Schrodinger equation and probability interpretation of wave mechanics. Uncertainty principle. Application to one dimensional problems, the harmonic oscillator, orbital angular momentum, and the central force problem. Quantum theory of scattering. Born approximation. Phase shift analysis. Introduction to S-matrix theory. General formulation of quantum mechanics in Hilbert space. Spin. Identical particles and symmetrization principle. Time-independent and time-dependent perturbation theory. Semi-classical theory of radiation and atomic spectra. Addition of angular momentum. Wigner-Eckart theorem. Quantum theory of radiation. Absorption, emission, and scattering of photons. *Prep. 11.240.*

**11.848 Advanced Quantum Theory (4 q.h.)**

Introduction to the formulation of a relativistic quantum theory. Study of the Dirac equation and its Lorentz covariance. Plane wave solution of the Dirac equation, and projection operators. Bound state solutions of the Dirac equation in a Coulomb field, and the hydrogen atom. Parity, charge conjugation, and time reversal symmetries. Propagator theory. *Prep. 11.843.*

**11.86A, 11.86B, 11.86C Particle and Nuclear Physics A, B, C (3 q.h.)**

The first quarter is a study of nuclear physics with emphasis on the nature of nuclear forces and its connection to particle physics. Phenomenological models are examined and compared with experimental results. The second and third quarters are a study of elementary particles and their interactions. A basic classification of elementary particles is made, along with a summary of their strong, weak, and electromagnetic interactions. Lorentz invariance and other symmetry principles are used to extract theoretical statements about scattering and decay amplitudes, and particle mass spectra. *Prep. 11.843 and concurrent with 11.848.*

**11.87A, 11.87B Solid State Physics A, B (4 q.h.)**

Adiabatic approximation and theory of lattice vibrations of perfect crystals. Phonons, polaritons, and their measurement. One-electron approximation of solids and theory

of Bloch electrons. Metals, semiconductors, and insulators. Thermal properties. Bloch electrons in external fields. Electron-phonon interaction. Electrical and thermal conductivity. Theory of transport phenomena. Magnetic properties. Amorphous solids. *Prep.* 11.827, 11.842.

### III ADVANCED ELECTIVES

#### 11.804, 11.805, 11.806 Advanced Solid State Physics A, B, C (4 q.h.)

Selected advanced topics in the theory of solids to be chosen each time by the interested students and instructor. E.g.: Theory of normal metals. Hartree-Fock and Random phase approximations. Optical and transport properties. Solid-state plasmas. Raman spectroscopy. Quasiparticles and collective excitations. Quantum solids. Amorphous solids, etc. *Prep.* 11.829, 11.843, 11.87B. Offered every other year.

#### 11.817 Foundations of General Relativity

The course discusses the physical basis underlying relativity (the weak and strong principle of equivalence), the role of the metric tensor as a carrier of gravitational information, and the modification of the Lorentz covariant field equations in the presence of gravitation. An introduction to Riemannian geometry is given, and the Einstein field equations and tests of Einstein's theory are discussed. *Prep.* 11.825, 11.826, 11.836, and 11.843.

#### 11.818 Relativistic Astrophysics and Cosmology

The course deals with the equations for the relativistic stellar system, white dwarfs, neutron stars and properties of pulsars, gravitational collapse and black holes, quantum radiation from black holes, super heavy stars as possible quasar energy sources, quantum effect in gravitational collapse, the metric for cosmological systems, and the big bang theory. *Prep.* 11.817 and 11.848.

#### 11.819 Quantum Gravity

The course deals with gravitation as a quantum field, threshold properties of gravitational quantum S-matrix, quantization leading to a set of Feynman rules, calculations of simple tree diagrams, closed loop infinities and the problem of renormalizability of quantum gravity. *Prep.* 11.818.

#### 11.857, 11.858, 11.859 Many-Body Theory A, B, C (4 q.h.)

Introduction to some many-body problems and the required mathematical techniques. Theory of linear response and correlation functions. Landau's theory of Fermi liquids and applications to solids. Theory of superconductivity and superfluidity. General theory of Green's functions and diagrammatic techniques. *Prep.* 11.829, 11.843, 11.87B. Offered every other year.

#### 11.854, 11.855, 11.856 Fields, Particles, and Currents A, B, C (4 q.h.)

Introduction to a local field theory. Symmetries of the Lagrangian and conservation laws, Lorentz group, spin, and helicity. P, C, and T. Klein-Gordon, Dirac, vector meson and photon fields. The S-matrix and LSZ reduction formulae. Spectral representations. Feynman diagrams. Green's functions at large Euclidean momenta. Renormalization and finiteness. The renormalization group and asymptotic freedom. Gauge theories, spontaneous breaking and Higgs phenomenon. Weinberg's unified theory of weak and electromagnetic interactions. Currents. *Prep.* 11.848.



**11.837 Electromagnetic Theory D** (3 q.h.)

Advanced topics in electromagnetic theory such as problems involving radiation reaction, energy, momentum, and the equations of motion of a high-speed particle, Cerenkov radiation, the Lagrangian and Hamiltonian formulation of electromagnetism. *Prep.* 11.836.

**11.838, 11.839 General Relativity A, B** (3 q.h.)

A brief survey of differential geometry, physical basis of the Einstein equations, simple solutions and experimental tests, cosmology, asymptotic properties of the Einstein equations (radiation, energy, momentum), quantization of the theory. *Prep.* 11.837 and 11.826.

**11.91A, B, C** (1 q.h.)**11.92A, B, C** (2 q.h.)**11.93A, B, C** (3 q.h.)**11.94A, B, C** (4 q.h.)

Reading course, or theoretical or experimental work under individual faculty supervision. *Prep.* *Consent of faculty member.*

**11.995 Doctoral Dissertation**

Experimental and theoretical work for Ph.D. candidates.

# political science

## Professors

Walter S. Jones, Ph.D.  
Edward W. Brooke Professor  
R. Gregg Wilfong, Ph.D.

## Associate Professors

L. Gerald Bursey, Ph.D.  
Robert L. Cord, Ph.D.  
Robert E. Gilbert, Ph.D.  
Minton F. Goldman, Ph.D.  
David E. Schmitt, Ph.D., Acting Chairman  
Steve Worth, Ph.D.

## Assistant Professors

Seth I. Hirshorn, Ph.D.  
Edward McD. Humberger, Ph.D.  
Eileen McDonagh, Ph.D.  
Suzanne Ogden, Ph.D.  
Wendell C. Lawther, M.A.

## Adjunct Faculty

Elizabeth D. Bennett, S.M., J.D.  
Gordon Bowen, M.B.A.  
Thomas J. Cahill, Ph.D.  
Ernest W. Cook, Ph.D.  
Oleta L. Crain, M.P.A.  
Michael P. Curran, M.A., J.D.  
Maxim M. Dem'chak, M.P.A.  
Richard M. Doherty, M.A., J.D.  
Kevin T. Fitzpatrick, M.B.A.  
Etsie L. Foreman, M.A.  
W. Arthur Gagne, Jr., S.B., M.B.A.  
Richard Gladstone, M.A., M.C.P.  
Harry Grossman, L.L.B.  
James T. Hilliard, J.D.  
Paul G. Keough, M.P.A.  
Demeter J. Kollias, M.P.A.  
Ronald E. Lawson, M.B.A., M.P.A.  
Alexander MacMillan, J.D.  
Robert H. McClain, Jr., M.P.A.  
Harold J. Mezoff, M.P.A.  
Walter W. Mode, M.P.A.  
Richard B. Morrison, Ed.D.  
Robert J. M. O'Hare, M.S.  
Richard A. Siegel, Ph.D.  
Marvin Siflinger, M.P.A.  
Wallace Stickney, M.S.  
Richard E. Wall, M.A.  
John S. Warren, M.P.A.  
John A. Wolaver, M.B.A., M.U.A.

## Admission

In addition to the admission requirements listed on page 22, applicants for the Master of Arts program should have had a background which includes at least 15 semester hours of political science or government. All applicants must take the Graduate Record Examination.

Applicants for the Master of Public Administration program should demonstrate a clear and strong interest in public administration. All applicants for admission must furnish a statement that supports his or her interest in public administration and provides reasons for wishing to enter this program. Although it is anticipated that most candidates for this program will come with a major concentration in the social sciences, this is not mandatory, and applicants from other fields such as engineering, law, the sciences, and business administration will be considered for candidacy.

## **THE MASTER OF ARTS DEGREE**

### **Program**

Forty quarter hours of academic work are required including a four credit course in Scope and Method in Political Science, which should be completed at the outset of the program. With the approval of the faculty adviser, a maximum of nine quarter hours may be elected from graduate courses in other departments and a maximum of eight quarter hours may be elected from advanced undergraduate courses.

A thesis is optional with the approval of the chairman of the department. If approved, a thesis carries six quarter hours of credit.

### **Comprehensive Examination**

This examination will be held in accordance with the general graduate school regulations. Every candidate for the degree must pass examinations in two fields as prescribed by the department. Degree candidates are limited to two attempts at successful examination in each field. Choice may be made from the following fields: American Government, Comparative Government, International Relations, Political Theory, or Public Administration.

## **THE MASTER OF PUBLIC ADMINISTRATION DEGREE**

### **Program**

Forty-two quarter hours of academic work are required. All students must complete the following five courses:

- 22.871 Public Budgeting, or
- 22.872 Public Fiscal Management
- 22.874 Functions and Techniques of Public Management
- 22.880 Survey of Public Administration
- 22.882 Public Personnel Administration
- 22.885 Quantitative Methods in Public Administration

At least five additional courses must be selected from courses designated public administration electives. Not more than four courses may be selected from other graduate courses offered by the department or the University, and these must have the approval of the faculty adviser.

### **M.P.A. Concentrations**

Students may elect to declare an M.P.A. concentration after completing four courses. Concentration areas include: (1) Public Organization and Management, (2) Public Finance and Budgeting, (3) Public Personnel Administration, (4) State and Urban Administration, and (5) Policy Sciences. The concentrations seek to provide integrated course offerings in key public administration fields. Each concentration area is coordinated by a

full-time faculty member, who also serves as advisor to students in his or her area of concentration. For each concentration area students must take at least one required course and at least three of the concentration electives. They must also meet the above M.P.A. Program requirements.

### **Comprehensive Examination**

A candidate for the degree must pass a general examination in the field of public administration as a whole which will test both mastery of the literature and the ability to apply concepts in the field to problems of government. Degree candidates are limited to two attempts at successful completion of the comprehensive examination. Candidates who have selected an M.P.A. concentration area will be expected to answer at least one question in their concentration area.

## **DESCRIPTION OF COURSES**

*All courses carry three quarter hours of credit unless otherwise specified.*

*All courses are seminars.*

### **22.800 American Government**

Analysis in depth of selected problems in American government. Examples of problems are: transition of American political parties, legislative reapportionments, and the decline of Congress as a law-making body. *M.P.A. elective.*

### **22.805 Scope and Methods of Political Science (4 q.h.)**

This course is designed as an in-depth examination of the assumptions, principles, etc. that underlie contemporary political science. As such it invites the student to consider the present practice of the discipline in the light of its history and to critically evaluate the discipline in the interest of a greater understanding of nature and limits.

### **22.810 Models of Political Systems.**

A detailed examination and critique of current models of political systems.

### **22.812 Political Psychology and Socialization**

An examination of theories of political psychology, opinion formation and attitude change; of political ideology; of processes of individual political development and socialization; of effects on mass and elite political behavior; of attitudinal differences and differential socialization experiences; of individual political behavior and the political system.

### **22.815 Politics and the Mass Media**

Study of the role of mass media in the formation of public opinion, with special attention to use of the media in the electoral process.

### **22.820 Legislative Process**

Study of Congress and of the influence of the President, administrative bureaucracy, parties, interest groups, and public opinion on the development of legislative policy. Comparisons will be made with legislative process in the states. *M.P.A. elective.*

**22.821 Theories of American Political Participation**

This course will examine political behavior at both the national electorate level and at the level of legislative roll call voting, analyzing the relative impact of demographic and attitudinal components as well as the effect of constituency and partisan identification upon legislative behavior.

**22.822 American Constitutional Law**

Employing excerpts of U.S. Supreme Court decisions and other primary legal materials, this course examines the constitutional rationale for judicial review; various philosophical approaches to the exercise of judicial power; and the scope of judicial authority to settle questions challenging the legitimacy of governmental actions in the American constitutional system.

**22.823 American Constitutional Law II**

Using excerpts of primary legal materials, this course builds upon the judicial doctrines developed in 22.822 and specifically examines the constitutional theories behind the growth of congressional prerogatives in economic and social affairs, and expanding presidential power in internal and foreign matters. *Prep. 22.822 or consent of the instructor.*

**22.824 The Presidency**

Examination of the place and function of the chief executive in the formulation and execution of public policy. *M.P.A. elective.*

**22.826 American Electoral Behavior**

The theoretical and methodological assumptions of election studies of the American political system will be analyzed and the substantive conclusions carefully reviewed.

**22.827 Campaigns and Elections.**

A study of campaign tactics and strategies. Field work required.

**22.828 The Judiciary**

Analysis of the role of the judiciary in the American governmental process. Special attention is given to those areas of constitutional law where the Court's decisions have a profound impact on the basic structure of American politics (apportionment, economic regulation, federalism, etc.).

**22.829 Political Parties, Pressure Groups and Public Policy**

A study of the role of parties and pressure groups in the policy making process; trends in contemporary party politics will be examined as well as behavior patterns of the American electorate.

**22.830 Civil Rights**

Examination of the doctrine of constitutionalism illustrated and amplified by a study of the substance and process of the Bill of Rights as developed in decisions of Federal courts, and Congressional enactments.

**22.831 Procedural Due Process**

Utilizing excerpts from U.S. Supreme Court decisions and other legal materials, this course examines the philosophical and constitutional relationships between Amendments 4, 5, 6, 8 and the Fourteenth Amendment. The substance of the right to

fair trial, counsel, confrontation, protection against self-incrimination and unreasonable searches and seizures are among the many procedural rights examined through the decisions of the Roosevelt, Vinson, Warren, and Burger Courts.

### **22.832 Intergovernmental Relations**

An institutional-behavioral analysis of the changing relationship between the various levels of American government — national, state, and local — relating the pattern of change to the social and economic forces which underlie it. *M.P.A. elective.*

### **22.834 Constitutional Law in Public Administration**

An introduction to American Constitutional Law and the Federal system using case materials and emphasizing principles of importance to public administrators, including such constitutional concepts as separation of powers, judicial review, dual federalism, legislative investigating power, executive impoundment, federal preemption and the appointment and removal power. *M.P.A. elective.*

### **22.835 Administrative Problems in Criminal Justice**

An examination of the criminal justice system in the United States with particular emphasis on political and administrative factors. Emphasis on the role of police, courts, judges, juries, parole, probation and incarceration. *M.P.A. elective.*

### **22.838 Administrative Ethics in Public Management**

An analysis of ethical problems in American public administration including discussion of ethical dilemmas frequently faced by public managers. *M.P.A. elective.*

### **22.840 Problems in State Administration**

Appraisal of the problems of contemporary state government in the U.S. Particular emphasis is given to the state government of Massachusetts. Individual research is stressed. *M.P.A. elective.*

### **22.841 Problems in Urban Planning**

An exploration of the devices available to the urban planner for policy implementation, including zoning, subdivision regulation, and capital improvement programs. Special emphasis is given to the planning of individual sites. *M.P.A. elective.*

### **22.842 Techniques of Urban Planning**

A study of the history and techniques of city planning, stressing the elements of planning. *M.P.A. elective.*

### **22.843 The Politics of Urban Planning**

An investigation of the relationships of planning to other governmental functions with stress on practical processes, particularly at the municipal government level. *M.P.A. elective.*

### **22.844 Urban Administration**

The contemporary crisis in urban government — problems of political independence, government finance and administration, rapid growth of suburban and metropolitan areas, and decline and decay of the core city are stressed. Particular emphasis is given to the Boston metropolitan area. Individual research is stressed. *M.P.A. elective.*

**22.845 Problems of Urban Administration**

Selected case problems and topics in municipal administration including organization, financial management, personnel and labor relations, municipal services, and public and political relations. Individual research is stressed. *M.P.A. elective.*

**22.846 Problems of Regional Development**

An examination of the role of government and politics in the planning, programming, and administration of regional and urban development in the United States. Consideration is given to urban renewal; interurban and interregional competition; interstate compacts; public authorities; T.V.A., Appalachia, and New England regional development; anti-poverty programs; and conflicts between public and private interests. Individual research is stressed. *M.P.A. elective.*

**22.847 The Politics of Transportation**

Examination of the role of politics, governmental mechanisms and public policy in the transportation planning process. Particular attention is given to political interest groups and the manner in which they affect transportation policy on the federal, state and local levels. *M.P.A. elective.*

**22.848 Problems of Community Development**

Examination of the role of government, politics and public policy in the urban process and related problems in the United States. *M.P.A. elective.*

**22.850 Comparative Politics I**

Comparative analysis of politics and political systems with special attention to fundamental problems of theory and practice. The chief focus is on contemporary political systems and contemporary theories in the field of comparative politics. Traditional models are also treated, but more briefly. Particular attention will be paid to British and American political experience.

**22.851 Comparative Politics II**

Extends and intensifies the comparative analysis of politics undertaken in Comparative Politics I by examining a broader range of institutional experience. Special attention will be given to European political experience, particularly that of France and Germany. *Prep. 22.850.*

**22.852 European Political Parties**

A comparative cross-national study of political organization and behavior in England, France, and Germany with emphasis on party leadership, strategy, organization and constituency as well as socialization, recruitment, and participation of voters.

**22.853 Crisis Politics in Democracies and Dictatorships**

Analysis of governmental response to crises and emergencies. Consideration of such topics as war powers, riots and rebellions, martial law, transfer of regime, succession problems, economic crises, presidential emergency powers, national security powers, executive privilege, impeachment, etc.

**22.854 Totalitarianism**

An analysis of totalitarianism and dictatorship including study of historical background; fundamental characteristics; theories of origin, nature, and significance;

and evaluation of techniques, ideologies, policies, and instruments of power. Special attention will be given to the government and politics of the Soviet Union.

**22.855 Government and Politics in Germany**

A study of political culture, federalism, and executive-legislative relations on the national level with a view to appraising the quality and durability of the present democratic system.

**22.856 Government and Politics of France**

A study of governmental organization and political behavior in France today. Special attention is given to the role of the presidency, executive-legislative relations, and the political party system.

**22.857 European Legislative Systems**

A comparative analysis of the legislatures in Britain, France, and Germany with emphasis on patterns of historical development, functions, internal organization and relations with the executive.

**22.858 Government and Politics of the United Kingdom of Great Britain and Northern Ireland**

An analysis of government organization and political behavior in the United Kingdom. Special attention will be given to executive-legislative relations, the political party system, and the politics of Northern Ireland.

**22.859 European National Executives**

A comparative cross-national study of executive decision making in England, France, and Germany with emphasis on varying patterns of presidential and cabinet authority as well as relationships with the legislature.

**22.860 Collective Bargaining in the Public Sector**

Study of the mechanisms for labor relations in federal, state and local government with its impact on the public manager. Emphasis is placed upon collective bargaining processes, tactics, and techniques. *M.P.A. elective.*

**22.861 Grantsmanship**

Instruction in ways to prepare well-conceived, adequately documented, and logically developed grant proposals. Consideration will also be given to the political strategies of proposal submission. *M.P.A. elective.*

**22.863 Management Information Systems**

The course studies the life cycle of a management system through its three phases: (1) study and design; (2) implementation; and (3) operation within the target organization. It will explore the impact which management information systems have and may in the future have on governmental managers, on their professional environment, and on the society which they serve. Various government MIS will be studied. The course requires no mathematical or data processing background. *M.P.A. elective.*

**22.864 Problems in Computer Applications**

Definition and study of the characteristic weaknesses and failures of information systems with use of case studies to examine problems in governmental computer



applications. Particular emphasis on management's role in minimizing or eliminating problems of system control, error detection, audit, security, hardware reliability and manufacturer support. *M.P.A. elective.*

#### **22.865 Computer Techniques in Public Administration**

A general orientation to the computer, its uses and operation, with particular attention to programming analysis, preparation and coding, and use of computer programs specifically written for governmental applications. *M.P.A. elective.*

#### **22.867 Health Care Management**

An exploration of concepts in managing health care systems with special emphasis on management as it relates to policy, organization, and development of health care programs and institutions. *M.P.A. elective.*

#### **22.868 Politics of Health Care Administration**

An examination of the politics and administration of health services delivery systems, including a discussion of current topics in health care administration and politics (e.g. national health insurance, health maintenance organizations, physician assistants, citizen participation, administrative decentralization), and an introduction to current developments in policy evaluation methodology and health services research. *M.P.A. elective.*

#### **22.870 Public Budgeting and Fiscal Management**

An overview of money management, budgeting, and allocation processes and problems in public organizations. *M.P.A. elective.*

#### **22.871 Public Budgeting**

Emphasizes the public budgeting function in its relationship to other functions of public administration. Business budgeting in contrast with public, conflicting legislative, and executive interests are examined; illustration is given of the budget cycle and the mechanics of budget preparation; attention is given to means for improving budget decision-making and administration with use of quantitative and other methods.

#### **22.872 Public Fiscal Management**

A study of the interrelationships in public administration between systems of finance and the achievement of program objectives. Emphasis is placed upon those aspects of the budgetary process that bear on fiscal policy and appropriations.

#### **22.873 Systematic Analysis and Public Finance**

A conceptual examination of the Planning, Programming and Budgeting System (PPBS) and its application to the decision-making and budgetary processes in the public sector. An overview of the elements of the system and their application in determining optimum allocation of public funds. Specific examples will be discussed. *M.P.A. elective.*

#### **22.874 Functions and Techniques of Public Management**

An introduction to problems in public management and techniques for dealing with them. This will include functions of middle management, supervision, administration of staff activities (e.g. planning, personnel, budget), organization and methods, public relations, managerial use of computer-based techniques, and tactics and strategies of management.

**22.876 Administrative Behavior**

An analysis of the sociological and psychological aspects of organization and management. Topics include: bureaucratic leadership; interaction of individual and organization; dynamics of the small group; pathology of bureaucratic behavior. *M.P.A. elective.*

**22.877 Public Policy and Environmental Control**

Consideration of the legal, political, administrative, and intergovernmental factors involved in the formulation of public policy and the exercise of public power in regulating the use of the environment. Individual research is stressed. *M.P.A. elective.*

**22.879 Science, Technology, and the Administration of Public Policy**

An analysis of central administrative and policy issues raised by the interrelationships of science and public affairs. Some issues to be discussed: effects of technological development upon the development of policy alternatives and their implementation; national policy for support of science and technology; the administrative role of the expert. *M.P.A. elective.*

**22.880 Survey of Public Administration**

Introduction to the literature and the major topics in public administration with special attention given to the interrelationships of politics and administration.

**22.881 Special Issues in Public Personnel Administration**

Selected issues and problems will be examined in depth. *Prep. 22.882. M.P.A. elective.*

**22.882 Public Personnel Administration**

Technique, practice, and organization of personnel functions in public administration, including recruitment, compensation, training, discipline, and relations with employee organizations. *M.P.A. elective.*

**22.883 Comparative Public Administration**

A comparative study of the approaches to public administration in selected democratic governments in the United States and Europe. *M.P.A. elective.*

**22.885 Quantitative Methods in Public Administration**

Application of statistical techniques to Public Administration. *M.P.A. elective.*

**22.886 Advanced Quantitative Methods**

Seminar instruction on either individual or small group projects emphasizing the application of methodology to administrative problem-solving. Specific topics vary quarter-to-quarter and are oriented toward the needs and interests of student participants. *M.P.A. elective.*

**22.887 Regional Administration**

An examination of the growth and development of intrastate and interstate regional councils, together with their relations with local, state, and federal governments. Examples throughout the nation will be studied, and a detailed analysis made of regional councils in Massachusetts. *M.P.A. elective.*

**22.888 Federal Administrative Law**

Study of rule-making, adjudication (formal and informal), administrative finality and judicial review, administrative procedure, scope of administrative powers, and enforcement techniques. *M.P.A. elective.*

**22.889 Governmental Accounting**

Examination of principles and procedures involved in governmental accounting. *M.P.A. elective.*

**22.890 Research Seminar In Public Administration**

Will require each student to develop and report upon an individual research project in public administration. This seminar will normally be taken in the last quarter of study for the M.P.A. degree. *M.P.A. elective.*

**22.891 Public Administration and Economic Impacts**

An analysis of the impact of economic variables on the administrative process. Special attention will be given to the administrative problems posed by inflation and recession. *M.P.A. elective.*

**22.892 Techniques of Policy Analysis**

The purpose of this course is to familiarize the student with various techniques useful in analyzing public policy issues. Case studies of specific applications of such methods as modeling, simulation, and survey research will be examined. *M.P.A. elective.*

**22.893 Productivity and Public Policy**

The purpose of Productivity and Public Policy is to familiarize the student with public sector productivity analysis. Studies employing productivity measures, primarily dealing with urban and federal levels of government, will be discussed. The final few weeks of the course will focus on uses of productivity measures, especially personnel and program evaluation. As part of the course requirements, students will design a productivity study for a federal, state or city agency. *M.P.A. elective.*

**22.894 Techniques of Program Evaluation**

A review of the various methods used to assess public policy including identification and categorization of outcome, input and program operation variables; and the types of research designs and the steps needed to institute program change after completion of an evaluation study. *M.P.A. elective.*

**22.895 Motivation and Management**

An examination of current sociological and psychological theories on the subject of motivations of individuals in organizations and of the effects of their application. *M.P.A. elective.*

**22.896 Management Planning for Public Organizations**

A review of the growth of the planning approach to public management and of its application in specific agencies. Topics include organization of the management planning function, budget planning and methods of providing planning forecasts. *M.P.A. elective.*

**22.897 Management by Objectives**

A course designed to provide a basic understanding of MBO and to prepare the stu-

dent to prepare, develop and implement an MBO System in a public agency. Topics will include objective setting and resource allocation, organizational development, work planning and control. *MPA elective.*

### **22.898 Organizational Psychology and Behavior**

The primary objective is to familiarize the student with the literature, theories and concepts of administrative behavior as it has evolved, and then to focus on the development of self-awareness and the building of interpersonal skills. *M.P.A. elective.*

### **22.899 Public Issues in Human Resources**

Discussion of the origins and development of the Social Security Public Assistance Income Maintenance and various health care programs. The course content will focus on controversial public policy issues of retirement, survivors, disability insurance, aid to families with dependent children, medicare and medicaid. The objective of the course is to develop understanding of the push and pull of many different viewpoints involved in public policy development. *M.P.A. elective.*

### **22.900 Ancient and Medieval Political Thought**

The development of political thought from Greek antiquity to the end of the Middle Ages. Both historical and analytical approaches will be utilized. Attention is also paid to the cultural, social, and intellectual context within which political theories develop.

### **22.905 Affirmative Action**

An analysis of the impact of affirmative action programs on public personnel administration. Topics include the Equal Employment Opportunity Act of 1972 and subsequent executive orders; commencement and maintenance of affirmative action programs; and the use of affirmative action to improve personnel functions. *M.P.A. elective.*

### **22.906 Position Classification**

An examination of the bases of position classification at the state, federal and local levels. After reviewing the process of job analysis the course will emphasize several classification schemes, including the new Federal factor benchmark system. Final topics will include wage and salary administration. *M.P.A. elective*

### **22.907 Recruitment and Selection**

A study of the bases of recruitment and selection including the use of manpower planning and the use of testing. *M.P.A. elective*

### **22.909 State and Regional Planning**

A course designed to familiarize students with the comprehensive planning of state services, including the development of program objectives, alternative implementation strategies and their evaluation. *M.P.A. elective.*

### **22.910 Modern Political Thought**

Examination of political thought from Machiavelli to Marx.

### **22.911 Energy Development and Conservation**

A non-technical review of the energy problems of the United States in general and the New England region in particular. All potential sources of energy are explored as

well as the need for continuous increases in the energy supply and the potential for energy conservation. Comparative analyses are presented to provide a basis for action to those who must participate in energy-related decision making. *M.P.A. elective.*

### **22.920 Contemporary Political Theory**

The main currents of political thought in the latter half of the nineteenth and the twentieth centuries with special emphasis on the relations between political theory, philosophy, and political science.

### **22.922 The Measurement of Political Events**

The purpose of this course is to acquaint political science majors with some analytical and mathematical tools appropriate for use in studying politics.

### **22.924 Strategy in Politics**

An examination of formal theories of political behavior, stressing elements of strategy and their implications. Relationships between political actors, patterns in political processes, bargaining, decision making, and voting will be covered.

### **22.926 Trends in American Political Thought**

Examination of intellectual concepts and movements that have informed and influenced American political life with emphasis upon those relating to the making and execution of public policy. *M.P.A. elective.*

### **22.927 Organizational Development**

An examination of Organizational Development as a management technique designed to increase organizational effectiveness by emphasizing the personal growth of employees. Specific topics include intergroup and interpersonal cooperation, resolving intergroup conflict, team management, and planned organizational change. *M.P.A. elective.*

### **22.928 Organization Theory**

An in-depth study of the major organization theories including the scientific basis for organization theory; models and ideal types; decision-making; application of game theory; systems analysis. *M.P.A. elective.*

### **22.929 Organizational Analysis and Change**

A study of the structure and processes of organization essential for problem-solving and for effecting organizational change. Emphasis is placed upon the application of social science theory and administrative principles in administrative problem identification and problem resolution. *M.P.A. elective.*

### **22.930 Positive Political Theory**

An examination of the works of Anthony Downs, William Riker, and others in this current school of political analysis.

### **22.931 Environment and Energy**

An analysis of environment and energy problems facing the American administrative system. The interrelationships of environment and energy policy will be discussed. Special attention will be given to new administrative requirements placed on administrators in government agencies not directly connected with environmental and energy affairs. *M.P.A. elective.*

**22.932 State Finance and Budgeting**

This course explores the many channels that the state budget must travel before it becomes a viable document. The several ways by which the budget can be affected before and after it is signed into law will be explored in depth. *M.P.A. elective.*

**22.933 Revenue Sources for Local Government and Public Organizations**

Selected sources of revenue, other than local taxes, will be studied from administrative and political perspectives. Case studies will be used to analyze real and in-kind revenue sources such as: philanthropy, concessions, fees for service, volunteerism, resource recovery and multi-town consortia for public services. *M.P.A. elective.*

**22.935 Urban Planning Workshop I**

The course is intended to enable the student to experience the actual decision making that goes into the formulation of local communities' comprehensive plans. A knowledge of the material covered in course 22.842. Techniques of Urban Planning is a prerequisite. *M.P.A. elective.*

**22.936 Urban Planning Workshop II**

Continuation of Urban Planning Workshop I. *M.P.A. elective.*

**22.937 Forms of Municipal Government**

After a review of the powers and functions of municipal government, this course will undertake an in-depth examination and analysis of the several forms of organizations employed by municipal governments in the U.S. (mayor-council, commission, council-manager, and town meeting). Examination will be made of various sub-categories within these broad areas, e.g., strong mayor, weak mayor, council-at-large, council from districts, open town meeting, representative town meeting, town manager, and executive secretary. *M.P.A. elective.*

**22.938 Municipal Finance and Budgeting**

A discussion of the special problems of budgeting and finance in local governments, including budget preparation and presentation, debt management, capital financing and local taxation policy. *M.P.A. elective.*

**22.939 Municipal Law**

Designed for the non-lawyer, this course will review the law of municipal corporations. Topics will include general powers and duties, charters, ordinances, administrative rules and regulations, officers and employees, tort liability, policy powers, planning and zoning, taxation and borrowing, elections, licenses and permits. *M.P.A. elective.*

**22.940 Comparative Urban Administration**

This course will analyze decision-making structures and processes in selected urban areas. Topics will include: examination of world organization trends and implications for administration and politics of cities; changing scopes, scale, participants, and organization of urban politics; and selected issues such as urban housing, finance, leadership, planning and goals. *M.P.A. elective.*

**22.942 Asia and the Politics of Development**

This course relates the theoretical literature on political development to the concrete

attempts to develop in Asia. Because of the diversity in levels and types of political development in Asian states, each student is encouraged to concentrate on one state and explore different ideas about political development within the context of that state.

#### **22.943 The Governments and Politics of Latin America**

This course investigates contemporary Latin American politics with particular emphasis on militarism, revolution, executive dominance, and social change. It then focuses on three representative nations such as Mexico, Argentina, and Cuba.

#### **22.944 Nationalism**

The evolution and role of nationalism in both theory and practice. Representative nationalistic movements and theories are analyzed.

#### **22.946 The Politics of Revolution and Change**

Analysis of the nature of political change with attention to both theory and practice. Topics discussed are revolution, major trends in contemporary politics, and the relationship between political change and technological, scientific, or social change.

#### **22.948 Government and Politics of North Africa and the Middle East**

Comparative analysis of the political systems and foreign policies of African states north of the Sahara. Also stressed is the relationship of this area with the Middle East.

#### **22.950 United States-Soviet Relations**

The relations between the United States and the Soviet Union from 1917 to the present. Topics stressed are: the "nonrecognition" period, the breakdown of the World War II "Grand Alliance," and the nature of the present power conflict.

#### **22.951 United States-Far Eastern Relations**

American diplomacy in the Far East, with primary concentration on Japan since World War II, the two Chinas, and Southeast Asia.

#### **22.952 Communist China's Foreign Policy**

A study of the Peking government's relations with Afro-Asia, the Soviet orbit, and the West. Attention is given to policy objectives, strategy, tactics, and the method of decision making in both the party and state apparatus.

#### **22.954 Soviet Relations with Eastern Europe**

An analysis of Soviet policy in Eastern Europe, especially Russian efforts after World War II to develop communism and maintain a position of pre-eminence in this region.

#### **22.955 Chinese Politics**

This course concentrates on the objectives of the Chinese revolution from 1911 to the present. It examines the political theory and institutions which have been established to promote "permanent revolution" and evaluates the "rationality" of Chinese Communist policies in terms of Chinese goals.

#### **22.956 Government and Politics in Sub-Saharan Africa**

Comparative analysis of the political systems and foreign policies of selected African states south of the Sahara. Special attention is given to the Republic of South Africa and its policy of apartheid.

**22.958 Decision-Making In U.S. Foreign Policy**

Comprehensive analysis of the governmental mechanism and process for decision-making in U.S. Foreign Policy. Case studies in decision-making will be emphasized.

**22.959 American Foreign Policy**

Examination in depth of selected issues concerning the role of the United States in world affairs since 1945.

**22.960 Problems of World Order I**

Emphasizes such topics as appraisal of diverse systems of public order, approaches of international law and international organization to the problem of world order, and the problem of world peace enforcement.

**22.961 Problems of World Order II**

Political problems of world order are stressed. Representative topics are arms control and disarmament, limits of economic growth, global interdependence, overpopulation, and adequate global food distribution.

**22.964 The United Nations**

Selected topics on the "non-political" work of the United Nations: human rights; economic, social, health and related problems; decolonization and the trusteeship system.

**22.965 International Peace-Keeping**

A detailed investigation of the origins, history and theory of interventionary peace-keeping, with reference to the documentation of the United Nations. An assessment of this method of maintaining regional stability, and a projection of potential methods of developing the method to broader applicability.

**22.966 International Law**

Examination of selected topics in International Law not covered in 22.960 and 22.961.

**22.967 Regional Organization**

A study of international organization at the regional level, concerned with examining the capability of institutions to foster integration of policy and authority, and with the effect of this progress upon broader international cooperation.

**22.968 The Atlantic Community**

A topical analysis of European-American diplomacy with particular stress upon security and economic matters. Major consideration of the integration of Europe, American responses, and the results of these interactions for world political and economic stability.

**22.969 The United States and the United Nations**

A study of the pursuit of American foreign policy through the organs of the United Nations, with emphasis on the uses and effects of parliamentary diplomacy. Examination of the reasons for reversal of American attitudes toward the United Nations as the world moves toward multipolarity. Particular stress upon economic matters and the American role in the UN's quest for a New International Economic Order.



**22.980 Project Management**

A workshop course aimed at the development of practical skills in managing one-time projects. Use of case method to discuss techniques of problem identification, establishment of objectives, pre-entry strategies, data collection, project planning and control, project presentation and the image of temporary projects. *M.P.A. elective.*

**22.990 Assigned Reading** (maximum: 6 q.h.)

Assigned reading under supervision of a faculty member.

**22.991 Thesis** (6 q.h.)

Thesis supervision by individual members of the department.

**22.994 Seminar in Public Organization and Management**

Analysis of specified topics and issues in Public Organization and Management. Purpose of the course is to provide flexibility in presenting material of current interest and to allow in-depth research into specified areas where appropriate. Subject matter to be covered will be covered in registration materials. *M.P.A. elective.*

**22.995 Seminar in Public Finance and Budgeting**

Analysis of specified topics and issues in Public Finance and Budgeting. Purpose of the course is to provide flexibility in presenting material of current interest and to allow in-depth research into specified areas where appropriate. Subject matter to be covered will be published in registration materials. *M.P.A. elective.*

**22.996 Seminar in Public Personnel Administration**

Analysis of specified topics and issues in Public Personnel Administration. Purpose of the course is to provide flexibility in presenting material of current interest and to allow in-depth research into specified areas where appropriate. Subject matter to be covered will be published in registration materials. *M.P.A. elective.*

**22.997 Seminar in Policy Sciences**

Analysis of specified topics and issues in the Policy Sciences. Purpose of the course is to provide flexibility in presenting material of current interest and to allow in-depth research into specified areas. Subject matter to be covered will be published in registration materials. *M.P.A. elective.*

**22.998 Seminar in State and Urban Administration**

Analysis of specified topics and issues in State and Urban Administration. Purpose of the course is to provide flexibility in presenting material of current interest and to allow in-depth research into specified areas where appropriate. Subject matter to be covered will be published in registration materials. *M.P.A. elective.*

# psychology

## **Professors**

John C. Armington, Ph.D.  
Harlan Lane, Ph.D., Doc. ès Lettres  
Chairman  
Helen Mahut, Ph.D.  
Bertram Scharf, Ph.D.  
Murray Sidman, Ph.D.  
Harold S. Zamansky, Ph.D.

## **Associate Professors**

Edward A. Arees, Ph.D.  
Roger F. Brightbill, Ph.D.  
Perrin S. Cohen, Ph.D.  
Charles Karis, Ph.D.  
Harry A. Mackay, Ph.D.  
Alexander A. Skavenski, Ph.D.  
Lawrence T. Stoddard, Ph.D.  
Michael Terman, Ph.D.

## **Assistant Professors**

Martin Block, Ph.D.  
Karen Busby, Ph.D.  
François Grosjean, Ph.D.  
Joanne L. Miller, Ph.D.  
Claude Sigel, Ph.D.

## **Research Associates**

Leila R. Cohen, Ph.D.  
Juan S. Terman, Ph.D.  
Stuart M. Zola, Ph.D.

## **THE PROGRAM OF GRADUATE STUDIES**

The Department of Psychology offers a full-time program of graduate studies and research in experimental psychology leading to the Ph.D. degree. Applicants are considered only for the doctoral program; the M.A. is granted in the course of progress toward the Ph.D. Since the Ph.D. degree is awarded in experimental psychology, research accomplishment forms an essential and integral part of the doctoral program; students may expect to collaborate with faculty in conducting research in one or more of the following areas: learning and behavioral analysis; sensation and perception; neuropsychology; language and cognition; personality and social psychology.

Desirable experience includes laboratory courses in psychology and allied sciences as well as courses in mathematics. Applications should be filed by March 1, complete with official transcripts, three letters of recommendation, and scores on the Graduate Record Examination and the Miller Analogies Test.

Research assistantships and teaching assistantships carry a stipend of \$3,000 for the first year, \$3,000 for the second year, and \$3,300 for the third year, with remission of tuition. In addition, some positions are available in research and teaching during the summer. The department aims to support all graduate students requesting financial aid.

The first year of the graduate program is uniform for all students. It includes a proseminar in experimental psychology, a course in quantitative methods, and a seminar in instrumentation. In addition, all students choose

a research advisor and take an active part in one of the current research projects. Detailed descriptions of the current research projects are contained in the brochure, "Research in Psychology at Northeastern," available on request.

At the end of the academic year, each student's readiness for the doctoral program is determined on the basis of her or his performance in the two seminars and a written examination in the quantitative methods course. Equal emphasis is placed on the quality of laboratory research during the first year.

After that year, the structure of the doctoral program is very flexible and assumes that the process of learning and scientific discovery must be individualized. A wide variety of advanced seminars and courses is offered. Colloquia and in-house seminars bring students and faculty together to discuss ongoing research, often with visiting scholars from other institutions. Most important, students pursue their research projects under the expert guidance of their advisors. The advisors and projects available to students vary from year to year. Potential applicants are encouraged to visit the department in order to discuss their interests with the faculty and to observe the program and facilities first-hand.

## DESCRIPTION OF COURSES

*All courses carry three quarter hours of credit unless otherwise specified.*

### **19.817, 19.818, 19.819 General Experimental Psychology I, II, III (4 q.h.)**

The Departmental proseminar. Student presentations and discussions of the experimental literature in the following areas: learning and behavioral analysis; sensation and perception; neuropsychology; language and cognition; personality and social psychology.

### **19.808, 19.809, 19.810 Quantitative Methods I, II, III**

A survey of the quantitative methods used in experimental psychology, emphasizing applications of computer programming, theory of functions and relations, curve fitting, probability functions, set theory and analysis of variance.

### **19.980, 19.981, 19.982 Research Methods I, II, III (2 q.h.)**

Instrumentation and laboratory techniques through instruction and participation in ongoing laboratory projects.

## LEARNING AND BEHAVIORAL ANALYSIS

### **19.811, 19.812, 19.813 Programmed Learning Seminars I, II, III**

Students learn to evaluate instructional programs in the light of basic behavioral principles, and become acquainted with programming techniques in the normal classroom, special education classroom, in complex academic subject matter, and in individual problem areas. Students design, test, and evaluate instructional programs for teaching specific subject matter material, or for application to remedial problems, and to test basic instructional theory.

**19.820 Mental Retardation Seminar**

Interdisciplinary seminar in mental retardation. Faculty members from various Boston universities present lectures and direct discussion in their specialty areas. A broad range of topics within retardation is covered including genetic factors, administrative issues in federal, state, and local programs, impact of communication problems for the mentally retarded individual, and other related topics.

**19.821 Behavior Change In Institutions**

A review of successful projects which have been carried out to provide effective remediation in institutions for the mentally ill, the mentally retarded, the juvenile delinquent, and the developing human (in schools).

**19.835, 19.836, 19.837 Advanced Learning Seminars I, II, III**

These seminars cover contemporary research in operant conditioning, with emphasis on relating the techniques of behavioral analysis to problems of reinforcement, comparative psychophysics, and physiological psychology.

**19.912 Behavior Modification**

Survey and demonstrations of applied behavior analysis, with emphasis on behavior therapies, retardate training techniques, and classroom behavior modification.

**SENSATION AND PERCEPTION**

**19.828 Contemporary Psychophysics**

**19.830 Psychoacoustics**

This seminar deals with the relationship between sound and auditory perception. After five tutorial sessions on the physics and laboratory generation of sound, thresholds, masking, loudness, pitch, and sound localization, students will lead discussions based on research papers in the psychoacoustic literature.

**19.833 Perception**

A detailed consideration of research in such areas as form, space, and pattern perception, recognition, and the effects of set and motivation on perception. Physiological concomitants of perceptual phenomena will be considered.

**19.860, 19.861, 19.862 Vision I, II, III**

Seminars: classical and modern problems in vision. Recent journal articles will provide primary source materials for discussion. Consideration will be given to problems of stimulus specification, retinal structure, photochemistry, and psychophysical measures of sensitivity, color vision, and electrophysiology.

**NEUROPSYCHOLOGY**

**19.880, 19.881 Sensory Psychophysiology I, II**

Concentration on the anatomy and physiology of the various sensory systems, and correlation of these data with psychophysical and perceptual concepts. Laboratory work will be included.

**19.844, 19.845, 19.846 Physiological and Comparative Psychology I, II, III**

Seminars: a shared background, key concepts, and central issues of the field of physiological and comparative psychology.

**19.915 Biological Bases of Mental Retardation**

The course considers the relationship between biological malfunction, of the brain in particular, and the defective learning ability and other behavioral abnormalities which constitute mental retardation. The aim is toward as comprehensive a survey as time permits. Exercises include actual case presentations as illustrative examples.

**19.919 Neurochemistry and Behavior**

This seminar will examine different experimental approaches to the problems involved in uncovering the relationships between changes in brain activity and changes in behavior produced by drugs. Discussions will center on current theorizing on the role of early experience, environmental factors, biological rhythms, and other facets in the determination of drug-induced behavioral changes.

**19.952, 19.953 Neurological and Sensory Impairments Seminars I, II**

Etiology, assessment, and diagnosis, clinical characteristics, and education of the mentally retarded with visual, hearing, and motor deficits are studied. In addition to discussion participation, experiences are provided in evaluation and remedial programming, via application of operant techniques.

## LANGUAGE AND COGNITION

**19.870 Psycholinguistics**

Seminar. In depth analysis of research methods and findings in selected problems in the psychology of language, including developmental, anthropological, and experimental psycholinguistics.

**19.871 Psycholinguistics Laboratory**

Students perform modified replications of classical experiments in several areas of psycholinguistics and conduct and report a psycholinguistic study of their own design.

## PERSONALITY AND SOCIAL PSYCHOLOGY

**19.822 Psychopathology**

A detailed consideration of the major forms of psychopathology, including the neuroses (obsessional states, hysteria, anxiety states, phobias), the psychoses (schizophrenia, mania, depression, paranoia), psychosomatics, sociopathy, conduct disorders, organic disorders, and mental retardation.

**19.901, 19.902, 19.903 Personality Theory and Research I, II, III**

A survey of representative theoretical formulations of the normal personality and its development, and an examination of experimental evidence bearing upon relevant concepts and assumptions (anxiety, repression, aggression, cognitive styles).

### **SPECIAL TOPICS**

**19.807    Advanced Quantitative Methods and Instrumentation**

**19.990    Special Topics In Psychology** (maximum: (9 q.h.)

**19.991    Thesis** (6 q.h.)

Experimental work for the master's degree requirement.

**19.995    Dissertation** (0 q.h.)

Experimental and theoretical work for Ph.D. candidates.

# sociology and anthropology

## **Professors**

Morris Freilich, Ph.D.  
Blanche Geer, Ph.D.  
Frank F. Lee, Ph.D.  
Morton Rubin, Ph.D.  
Earl Rubington, Ph.D.

## **Adjunct Faculty**

Paul Dredge  
William Greenbaum  
Joan Laxson, Ph.D.

## **Associate Professors**

Patricia Golden,  
Ph.D., Acting Chairperson  
Elliott A. Krause, Ph.D.  
Lila Leibowitz, Ph.D.  
Jack Levin, Ph.D.

## **Assistant Professors**

Richard Bourne, Ph.D.  
Marcia Garrett, Ph.D.  
Freddie Hill, Ph.D.  
Wilfred Holton, Ph.D.  
Deborah Kaufman, Ph.D.  
Carol A. Owen, Ph.D.  
Alex Rysman, Ph.D.

## **Admission**

The general procedures and requirements are set forth on page 22. Students will normally be admitted to begin their graduate work in the Fall Quarter only. Applications received after March 15 will usually not be considered. Each application will be reviewed on its own merits. Any questions concerning the adequacy of the undergraduate background in sociology or anthropology will be considered individually. In some cases, students may be asked to make up certain deficiencies before proceeding to the basic requirements. Exceptions will be made with respect to procedural or substantive requirements on an individual basis if the circumstances seem sufficiently compelling.

In addition to examining the catalog and course offerings, all prospective candidates are urged to learn something about the scholarly interests and writings of our faculty and to talk with graduate students now in residence to ascertain whether or not we have something to offer in terms of their capabilities, needs, and interests.

**NB. Some of the requirements listed below for both the M.A. and Ph.D. will undoubtedly have been modified. Please check with the department and/or the graduate school for the most recent information. This applies also to course offerings.**

## **THE MASTER'S DEGREE**

The department offers graduate programs that lead to a master of arts degree in sociology or social anthropology. Forty-two quarter hours of B or better academic work are required for the degree. Certain advanced un-

dergraduate courses offered by the department may be taken for graduate credit with the approval of the department. Students must maintain a better than B average.

In general, students are encouraged to fashion a program of studies best suited to their needs and capabilities instead of following any single set of rigid requirements. To this end, all entering students should consult with the faculty adviser assigned to them, and other faculty members if possible, before registering for courses.

For the Master of Arts in Sociology, students are generally required to take two quarter courses in theory (usually 21.805, and 21.806) and two in methodology (usually 21.810 and either 21.811 or 21.916). The statistics requirement may be satisfied by achieving at least a B in 21.813 or its equivalent. All students are strongly advised to take some work in social anthropology.

For the Master of Arts in Sociology with an emphasis in Social Anthropology, students are generally required to take two quarter courses in theory (usually 20.805 and 20.802) and methodology. Other requirements will be individually determined. All students are strongly advised to take some work in sociology.

Students who can demonstrate proficiency in any of the requirements need not take those particular courses, and should petition the graduate committee for an opportunity to demonstrate proficiency.

A master's paper is required and earns four quarter hours of credit. This paper may be based on empirical or library research, and must be of publishable quality. It is expected that the full-time student will complete his master's paper no later than the end of his second year. Students planning to go on for the Ph.D. are urged to take the qualifying examination during their second year of residence as the results will be a major determining factor in deciding whether to encourage the student to try to go on or not.

### **Deadlines for Submission of Master's Paper**

A student must have substantially finished his master's paper as certified by his first reader on or before April 1 of the year in which he expects to be awarded the degree. Those who miss the April 1st deadline will normally have to wait until the subsequent fall quarter, and should not expect that a defense can be set up much before November 1st of that quarter.

## **THE DOCTOR OF PHILOSOPHY DEGREE**

The department offers the Ph.D. in sociology. A limited number of students will be enrolled in the Ph.D. program so as to provide highly personalized study and research training with individual supervision.

### **Admission**

Applicants to the doctoral program should apply for admission not later than March fifteenth of the year in which they expect to complete the requirements for the master's degree.



Students seeking admission whose master's degree is not in sociology will be considered on an individual basis. A tentative evaluation of the probability of advanced standing will be made at the time the student is admitted with the final determination after the qualifying examination has been completed.

Students completing their master's at Northeastern will be considered for admission to the doctoral program only after the results of their qualifying examination have been evaluated. Students completing their master's at another institution are admitted with the expectation that they will take the qualifying examination at the first available opportunity.

### **Residence Requirement**

The University's residence requirement can be satisfied by one year of full-time graduate work, or its equivalent, beyond the Master of Arts degree. If the M.A. has not been in sociology, a longer period of residence will undoubtedly be essential. Most students should expect to spend approximately two years or the equivalent in full-time graduate study beyond the requirements of the master's degree.

### **Degree Candidacy**

Degree candidacy is established in accordance with the general regulations of the graduate school.

### **Qualifying Examination**

Students will be examined on their ability to interpret readings and experience sociologically. A written examination is followed by an oral hearing where a) the strengths and weaknesses shown by the examination are discussed with the student and suggestions are made for remedying the weaknesses and b) in the light of these results a future course is charted for the student. The main purpose of this examination is diagnostic and should help both the department and the student to determine the best course of future action. Excessive weaknesses will lead to a recommendation to consider pursuing alternatives elsewhere.

### **Course Requirements**

Generally, thirty-three hours of academic work beyond the master's degree are required. However, the actual number needed by any particular student will be specially determined in each case. Depending on background, experience, and performance, a greater or lesser number of formal courses may be required. Decisions on special cases will be made by the Committee on Graduate Studies (COGS), acting in conjunction with the student, his adviser, and the chairman of the department. Students entering from another university may be required to take certain basic courses before proceeding with the doctoral program.

### **Language Requirements**

A reading knowledge of one language in which there is substantial sociological literature is required. Students must submit their choice to the COGS for approval. The language requirement must be satisfied before admission to the comprehensive examination. Statistics and/or advanced mathematics as well as languages needed primarily for field research are considered an integral part of the training of students specializing in such directions, and are therefore not the equivalent of the general language requirement.

### **Comprehensive Examination**

During the period of doctoral degree candidacy, each student must pass a comprehensive examination, the purpose of which is to ensure that the student has breadth in sociology in areas other than that pursued in the dissertation. Two "state of the art" papers are required in fields which are not close to that represented by the dissertation. When a student feels ready to undertake these papers, s/he must submit the choice of fields to the COGS for approval.

A student who wants to demonstrate breadth in sociology in another way must petition the COGS. The comprehensive examination must be passed at least nine months before the commencement at which the Ph.D. is to be awarded.

### **Doctoral Dissertation**

The student must submit a prospectus describing the topic of his doctoral dissertation, the methods of research, and the theoretical relevance of his problem. This prospectus is to be discussed with and approved by the dissertation committee consisting of the major adviser, two readers within the department and at least one reader from outside the department. The revised prospectus is then filed with the department.

### **Deadlines for Considering a Doctoral Dissertation**

The chairman of the dissertation committee should be fully satisfied that a dissertation is substantially complete on or before April 1 of the year in which the candidate expects to defend.

### **Final Oral Examination**

The dissertation will be defended after completion of all other requirements for the doctoral degree. This oral defense will be held approximately four weeks after the dissertation has been accepted by the dissertation committee, and at least two weeks before the commencement at which the degree is to be awarded.

**NB. Some of the requirements listed above for both the M.A. and Ph.D. will undoubtedly have been modified. Please check with the department and/or the graduate school for the most recent information. This applies also to course offerings.**

## DESCRIPTION OF COURSES

*All courses carry three quarter hours of credit unless otherwise specified.*

### SOCIAL ANTHROPOLOGY

*Many undergraduate courses in the 20.200 series may be offered for graduate credit. Students should check the current course announcements to take advantage of these offerings.*

#### **20.802 Theory (4 q.h.)**

History of major contemporary orientations: evolutionary approaches, culture area, cultural ecology, functionalism, structuralism, and analysis of current status of these and related theories.

#### **20.809 Human Origins**

An examination of the data on fossil remains and on contemporary primates which are essential for understanding human physical and behavioral evolution.

#### **20.815 Tribal Societies and Culture**

The structures and institutions of bands, tribes, and chiefdoms: comparative and functional studies of tribal societies and the dynamics of change under contact situations.

#### **20.820 Peasant Society and Culture**

Institutions of peasant society. The structure of traditional civilizations and the interrelations between urban and local communities: comparative and functional analysis of the peasant community and the dynamics of change from peasant to post-peasant and industrialized societies.

#### **20.825 Language and Communication**

Human communication, including language. Theories of the evolution of language and the application of models derived from the study of language to other aspects of behavior.

#### **20.828 Aggression**

Concepts of aggression as they have been used in evolutionary and comparative anthropological formulations. Professional and popular publications in anthropology, ethology, and psychology are analyzed.

#### **20.830 Individual and Culture**

Examination of current theory and method in the study of the interplay between personality and culture. Contributions by various disciplines are discussed.

#### **20.835 Kinship and Social Structure**

A variety of kinship systems and their terminological and structural components and the way in which their systems articulate with other social institutions.

**20.836 Family in Evolutionary Perspective**

The emergence of family from pre-human patterns, its biological and behavioral components, and its cross-cultural variations examined from an evolutionary perspective.

**20.840 Urban Anthropology**

Selected problems in anthropological studies in urban societies.

**20.850 Religion and Myth**

Nature and institutionalization of primitive, ancient, and contemporary religions. Exploration of religious concepts and movements in relation to social, religious, and political organization.

**20.860 Cultural Ecology**

Examines man's adaptation to environment and the effect of different human adaptations on natural systems.

**20.870 Evolution of Society**

The development of political and economic institutions: specialization, social stratification and the emergence of civilization.

**20.880, 20.881, 20.882, 20.883, 20.884, 20.885**

Ethnographic area courses (India, Africa, Mediterranean and others) will be offered as resources permit.

**20.950, 20.951, 20.952 Directed Study in Social Anthropology** (maximum: 9 q.h.)

Reading and empirical research in social and cultural anthropology supervised by members of the anthropological staff.

**20.980 Contemporary Issues in Social Anthropology**

Contemporary issues in the field of anthropology. Supervised readings and written reports on special problems.

**20.990 Seminar** (maximum: 9 q.h.)

Discussion of selected topics in the field of anthropology.

**20.991 Master's Paper in Sociology with an Emphasis in Social Anthropology** (4 q.h.)

Empirical or library research meeting the criteria for publication in a professional journal. *Supervision by members of the department.*

**SOCIOLOGY**

**21.805, 21.806 Foundations of Social Theory I and II** (4 q.h. each quarter)

The classic theorists (Durkheim, Weber, Marx, Simmel, and others) will be considered intensively.

**21.807 Contemporary Sociological Theories**

Analytic treatment of major contemporary theories such as functionalism, conflict, neo-Marxism, and others. *Prep. 21.806.*

**21.808 Recent Developments in Sociological Theory**

New horizons in theory and the relation of theory to research. Topics to be selected each year and announced by the instructor.

**21.810 Introduction to Research Methods I (4 q.h.)**

A survey of methods of social research including field study and participant observation techniques, survey techniques, interviewing and questionnaire construction, sampling procedures, experimental design, content analysis and use of available data.

**21.811 Introduction to Research Methods II (4 q.h.)**

Quantitative techniques of analysis. Students will conduct individual research projects.

**21.812 Current Issues in Social Research**

Selected topics will be examined.

**21.813 Statistical Methods for Sociologists (4 q.h.)**

This course is a detailed introduction to statistical methods most relevant to sociology. Topics include tabular analysis, non-parametric statistics, analysis of variance, regression analysis, path analysis, measures of association, estimation and univariate and multivariate hypothesis testing. The approach will presume a knowledge of elementary statistical theory.

**21.814 Mathematical Models and Advanced Statistical Methods for Sociologists**

This course will include selected topics in advanced sociological statistics: introduction to Markov chains, factor analysis, multiple classification analysis, and model building. The orientation will be toward the more advanced students and the approach will be somewhat mathematical. Some mathematical aptitude or at least one previous college course in mathematics is suggested. Graduate statistics (21.813) is a prerequisite.

**21.817 American Society**

Study of the development of and the changes in the institutional structure of American society in comparison with certain other social systems.

**21.820 Sociology of Deviant Behavior**

Applications of sociological concepts and principles to some problems of social disorganization in industrial societies. Analysis of such problems as suicide, prostitution, physical handicaps, unemployment, alcoholism, sexual deviance, and gambling. *Prep. 21.806.*

**21.822 Sociology of Poverty**

An analysis of sociological perspectives on causes of poverty, public views on poverty and institutional responses to poverty. A concern with policy issues and implementation of policies is emphasized. For advanced students in the social sciences and in the various human service schools of the university.

**21.827 Sociology of Delinquency**

Social and psychological factors of delinquency and their implications for prevention, rehabilitation, and treatment.

**21.832 Sociology of Crime and Justice**

A sociological and legal analysis of the criminal justice system, concentrating on police and law enforcement; plea-bargaining; courtroom research and trial

strategies; sentencing; and prisoners' right and corrections. The relationship between race, social class and crime is also considered, as are the sociological explanations of crime causation.

### **21.835 Theories of Criminology**

Theories and philosophies, underlying various correctional systems. Schools of thought in criminology and penology. Theoretical approaches to the crime and delinquency problem from the beginnings of criminology to current thinking.

### **21.837 Sociology of Law**

Fundamentals of law. The concept of social control. Order and Law. Consensus and conflict. Analysis of the normative-formative influences of law. Mores and morals. The concept of justice. Analysis of some legal institutions.

### **21.840 Sociology of Medicine**

Social aspects of illness and medicine, historically and cross-culturally. Illness and the medical profession in modern society and their structural settings: the community, the hospital, the medical school. Research studies in the field will be examined critically and problems for future research will be specified.

### **21.843 Sociology of Education**

The structure and functioning of educational institutions. Student, faculty, and administrative perspectives. Emphasis will be placed on the role of education in processes of socialization, social mobility, social change, and social control.

### **21.847 Formal Organizations: Administration and Structure**

Analysis of the goals and functions in modern organizations. Aspects of bureaucratization will be examined within business firms, public institutions, and private associations.

### **21.850 Sociology of Occupations and Professions**

The relations between the occupations and professions and society. Special topics may include occupational stratification, professional group behavior, recruitment and socialization of occupations and professions, and political activism.

### **21.855 Political Sociology**

Sociological analysis of power relations and power systems with special attention to the bases of political power, processes of change in power, and the part played by violence and revolutionary movements.

### **21.857 Economic Sociology**

The role of economic factors in the social process. Consideration will be given to both classic economic theory and its impact on classic social theory, and the potential interrelations between modern economic theory (especially model-building approaches) and general sociological problems.

### **21.860 Intergroup Relations**

The relations between various racial, nationality, cultural, and religious groups with emphasis on historical development. Particular attention will be paid to American society with its specific problems of adjustment and assimilation.

**21.861 Sociology of Prejudice and Discrimination**

A study of the characteristics, causes, and consequences of prejudice and discrimination, with particular reference to American society.

**21.863 Sociology of Religion**

A sociological analysis of religious institutions and experiences in their historical and contemporary content. Religion and political content will be considered.

**21.865 Sociology of Knowledge**

The relationship between the social base of a society and its intellectual products. The viewpoints of authors such as Marx, Weber, Mannheim, G. H. Mead, the Neo-Marxian, and other modern schools will be considered. *Prep. Three terms of graduate theory.*

**21.870 The Family**

Social structure and social functions of the family as a social institution. Relations between the family and other institutions in society will be examined comparatively and historically.

**21.873, 21.874 Childhood and Adolescence I, II**

Growth and development of the child in the social context. Primary socialization in the family including the transmission of role expectations, values, and the development of self concept. Secondary group socialization in school, neighborhood, and peer group.

**21.877 Theories of Socialization**

A critical examination of the major theories in the field. Attention will be focused on the work of Freud, Piaget, Cooley, Mead, Parsons, and Merton.

**21.880 Community Analysis**

Ecological theories of man's relation to his physical environment. Development of the concept, and discussion of methods for community study. Comparison between rural communities and urban neighborhoods. Discussion and evaluation of community action programs.

**21.881 Community Research Lab.**

**21.885 Urban Sociology**

Theories of the development of urban life. Comparisons between pre-industrial and industrializing urban areas. Methods for the study of urban social structure and change. Evaluation of contemporary metropolitan action programs.

**21.886 Seminar in Urban Social Policies**

Social science theories and methods are evaluated from the perspectives of urban affairs. *Consent of instructor.*

**21.887 Sociology of Policy, Planning and Evaluation**

A general introduction to the social, political and economic factors affecting policy formation and the eventual success or failure of social programs in health, education, welfare, and urban planning. Stress on evaluation of policy alternatives, and planning problems. For advanced students in the social sciences and in the various human service schools of the university.

**21.888 Metropolitan and Regional Issues**

Comparative analysis of problems, policies, programs, and activities associated with metropolitan and regional life. Includes assessment of values, institutions, networks, interest groups, decision-making, service delivery, growth and development, environment, equity, and integration. Case studies in societal context.

**21.889 Boston Seminar**

A case study in urban development, including the evaluation of environmental and historical circumstances, demands for services, response to events, programs. Basis for value systems of Yankees, ethnics, and cosmopolitans. Impact on downtown and neighborhood relations. Metropolitan prospects.

**21.890 Middle East Area Study**

Socio-cultural analysis of the Middle East. Ecological, structural, institutional, and normative factors in nomadic, rural, and urban life. Comparative regional analysis.

**21.895 Latin American Societies**

Study and analysis of selected Latin American societies with particular attention to such countries as Cuba, Mexico, Peru, and Brazil. Emphasis on urbanization and industrialization, social and political change.

**21.900 Issues in Social Psychology**

Human behavior and theories of self from a sociological and psychological perspective. Special consideration of interpersonal relations, socialization, and symbolic interaction.

**21.910 The Sociology of Science**

Selected topics dealing with interactions between science and society. *Consent of instructor.*

**21.912, 21.913 Experimental Methods In Social Research I, II**

This course covers experimental design and laboratory methods in sociology. The small groups laboratory is treated as a setting for testing sociological theory. The emphasis is upon techniques and problems in the creation and manipulation of social variables in the laboratory situation, although the techniques of the natural experiment are also considered.

**21.914 Rhetoric in Sociology**

Critical examination of the conventional forms of sociological writings. How conventions differ by theoretical perspective and paradigm.

**21.915 Seminar In Symbolic Interaction**

The social psychology of groups as found in the works of Mead, Becker, Blumer, Goffman, and others.

**21.916, 21.917 Seminar in Qualitative Analysis I, II (4 q.h. each quarter)**

Qualitative techniques of analysis. Social structure process and meaning in interacting groups. Each student studies a face-to-face group by means of participant observation using symbolic interaction concepts.



**21.920 Social Stratification**

Theories of inequality between groups in historical perspective, from classical to modern industrial times. Discussion and evaluation of sociological research in social stratification in regard to different social and cultural groups.

**21.930, 20.930 Social and Cultural Change S, A**

*Two-quarter course, in conjunction with Anthropology.*

Analysis of the changing patterns in social, economic, and political institutions. Modern social trends are discussed.

**21.940, 21.941 Social Control I, II**

Seminar in research, theories, and methods in the sociology of social control.

**21.950, 21.951 Seminar In Social Structure I, II**

Seminar relating current theories and research in sociology, social psychology, and social anthropology.

**21.960, 21.961, 21.962 Seminar on Socialization I, II, III**

I. Instructor reviews theories and findings in organizational socialization. II. Students design studies in organizational socialization. III. Students present results of their studies. *Not open to first year students.*

**21.980, 21.981, 21.982, 21.983 Contemporary Issues in Sociology**

Contemporary issues in sociology. Supervised readings and written reports on special problems.

**21.990 Seminar** (maximum: 9 q.h.)

Discussion of selected topics in the field of sociology.

**21.991 Master's Paper In Sociology** (4 q.h.)

Supervision by members of the department. Empirical or library research meeting the criteria for publication in a professional journal.

**21.992, 21.993, 21.994 Directed Study in Sociology** (Maximum: 9 q.h.)

Reading and research under the direction of a faculty member. *Open to doctoral candidates with the consent of the graduate committee.*

**21.995 Doctoral Dissertation**

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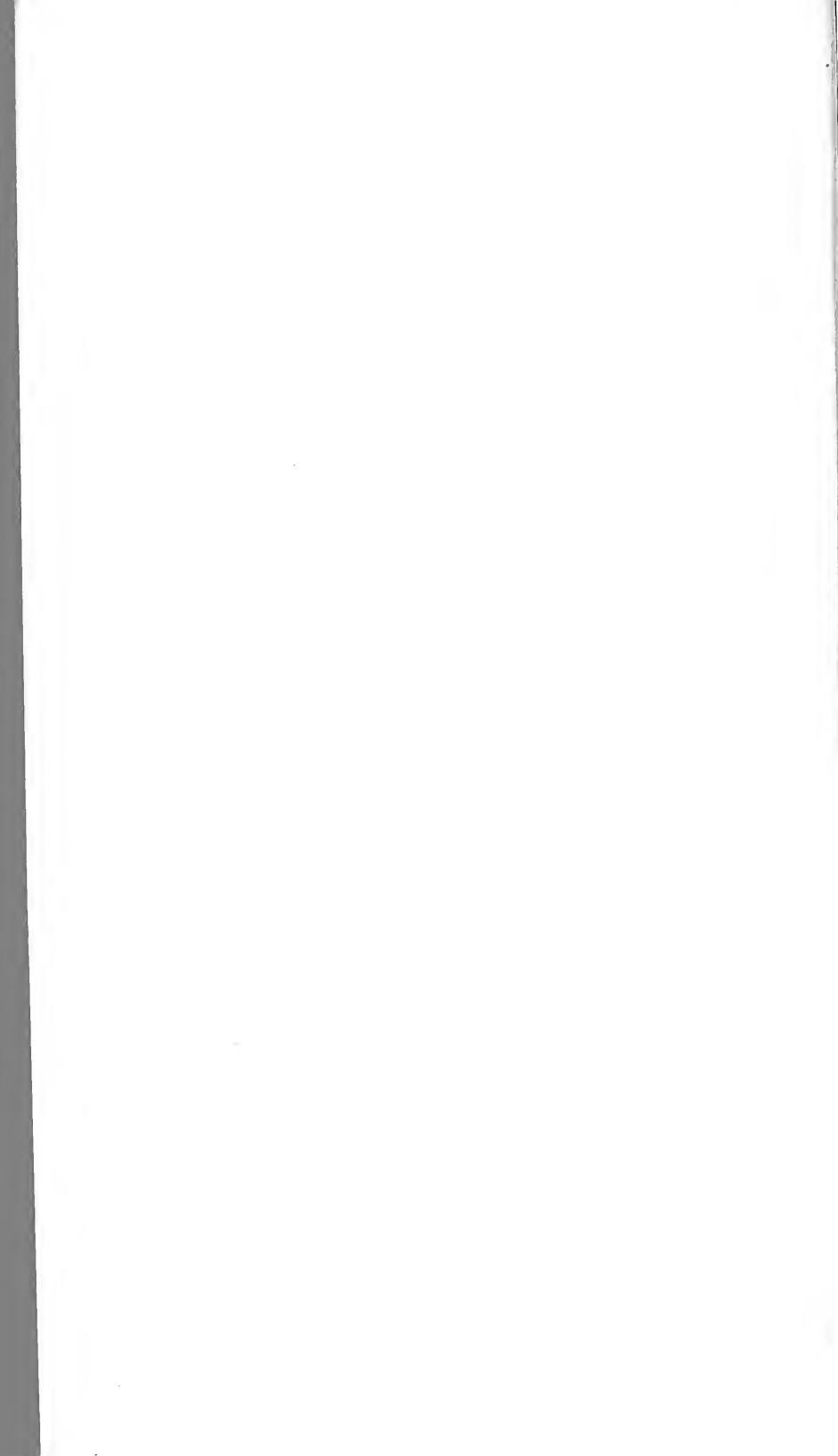
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